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(54) **SHOVEL**

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(57) **ABSTRACT**

A shovel (**100**) according to an embodiment of the present invention includes a lower-part traveling body (**1**), an upper-part swing body (**3**) that is turnably mounted on the lower-part traveling body (**1**), a hydraulic traveling motor (**2M**) as a traveling actuator that drives the lower-part traveling body (**1**), a space recognition device (**70**) that is provided in the upper-part swinging body (**3**), an orientation detection device (**71**) that detects information related to a relative relation between an orientation of the upper-part swing body (**3**) and an orientation of the lower-part traveling body (**1**), and a controller (**30**) as a control device that is provided in the upper-part swing body (**3**).

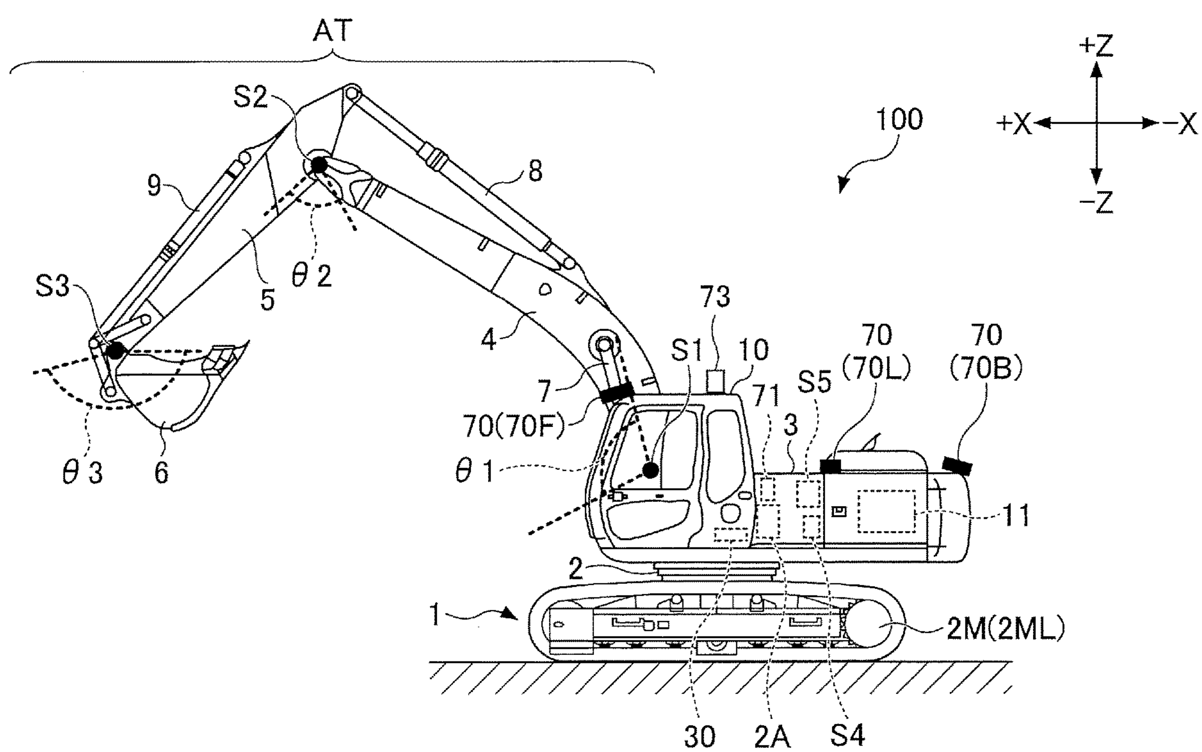


FIG.1

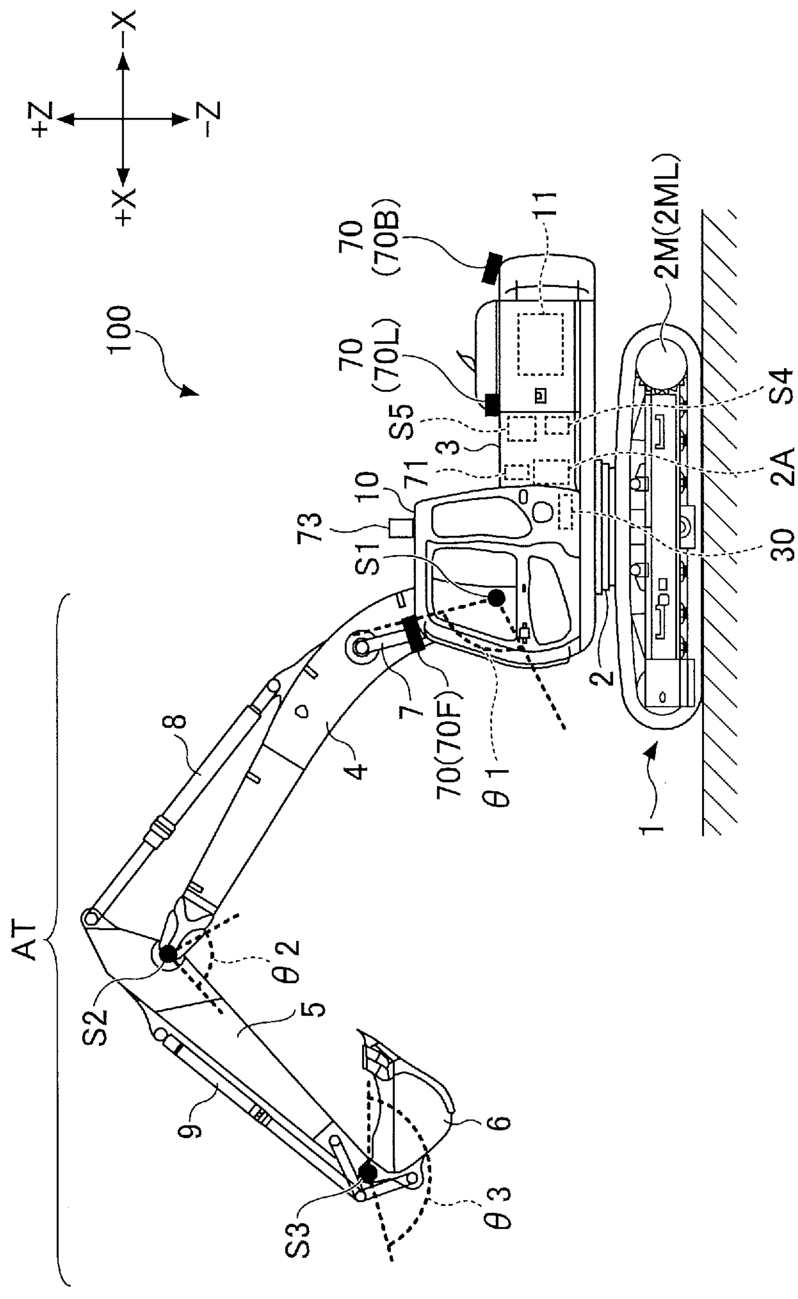

+X
-X
+Z
-Z
100
AT
70
(70B)
70
(70L)
11
2M(2ML)
S5
3
71
10
73
S1
S4
2A
30
2
7
70(70F)
θ1
4
8
1
θ2
S2
5
9
6
S3
θ3

FIG.2

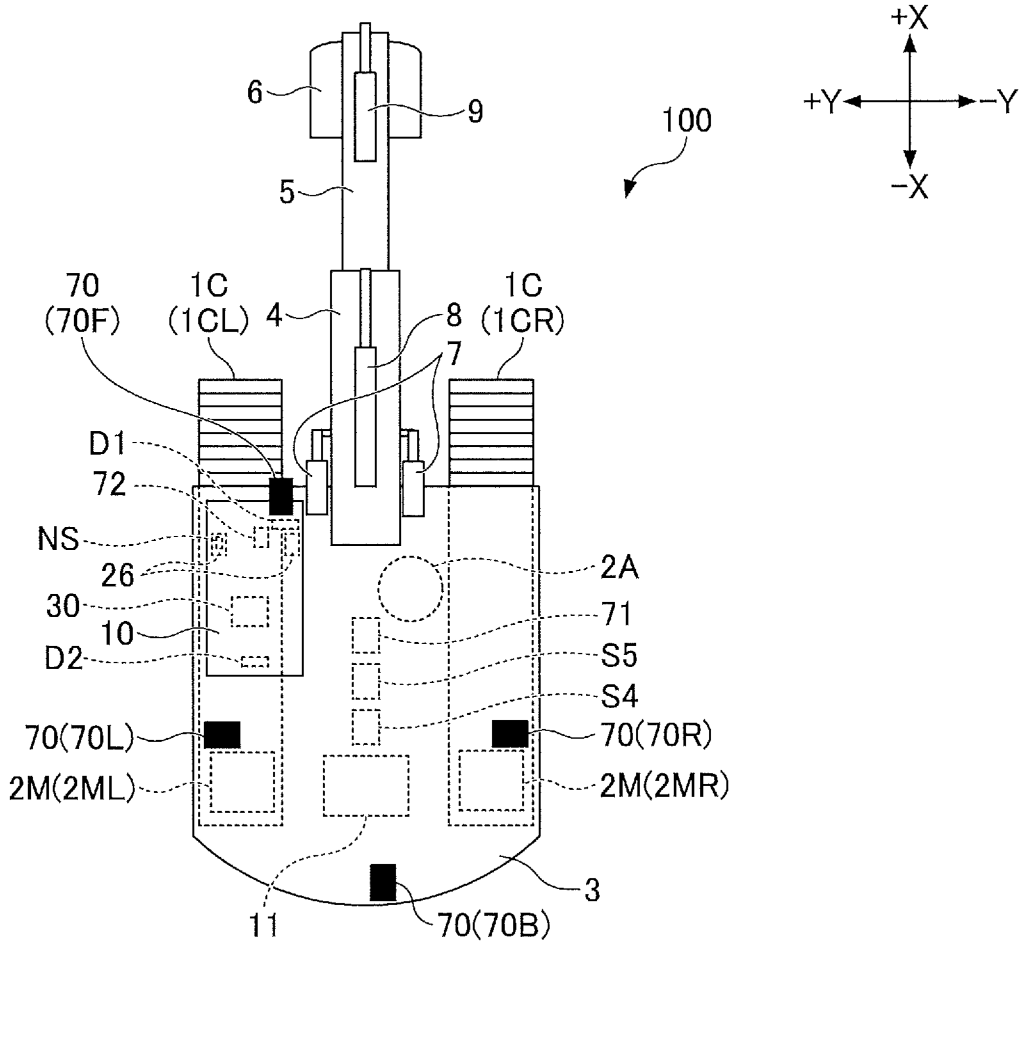
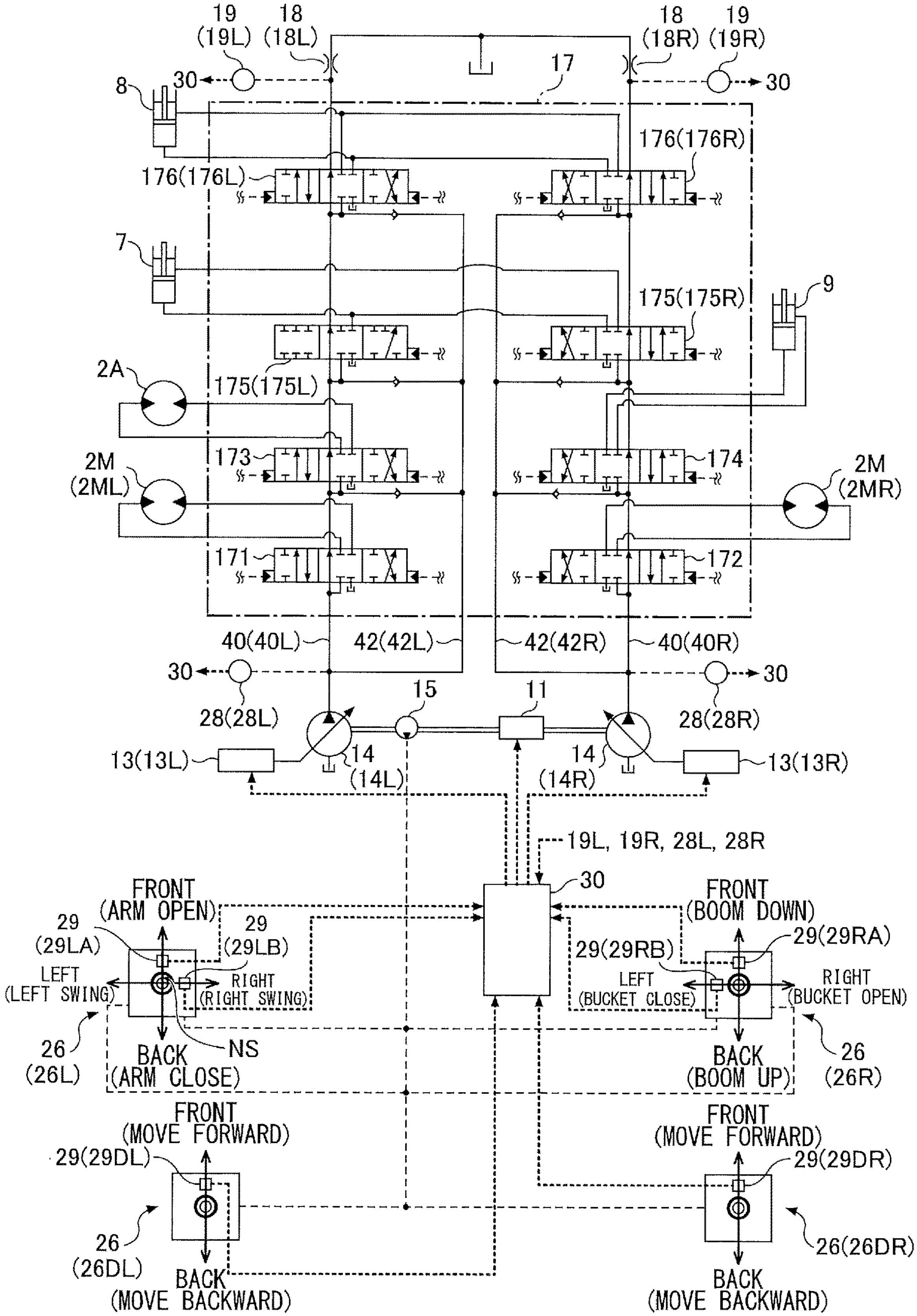
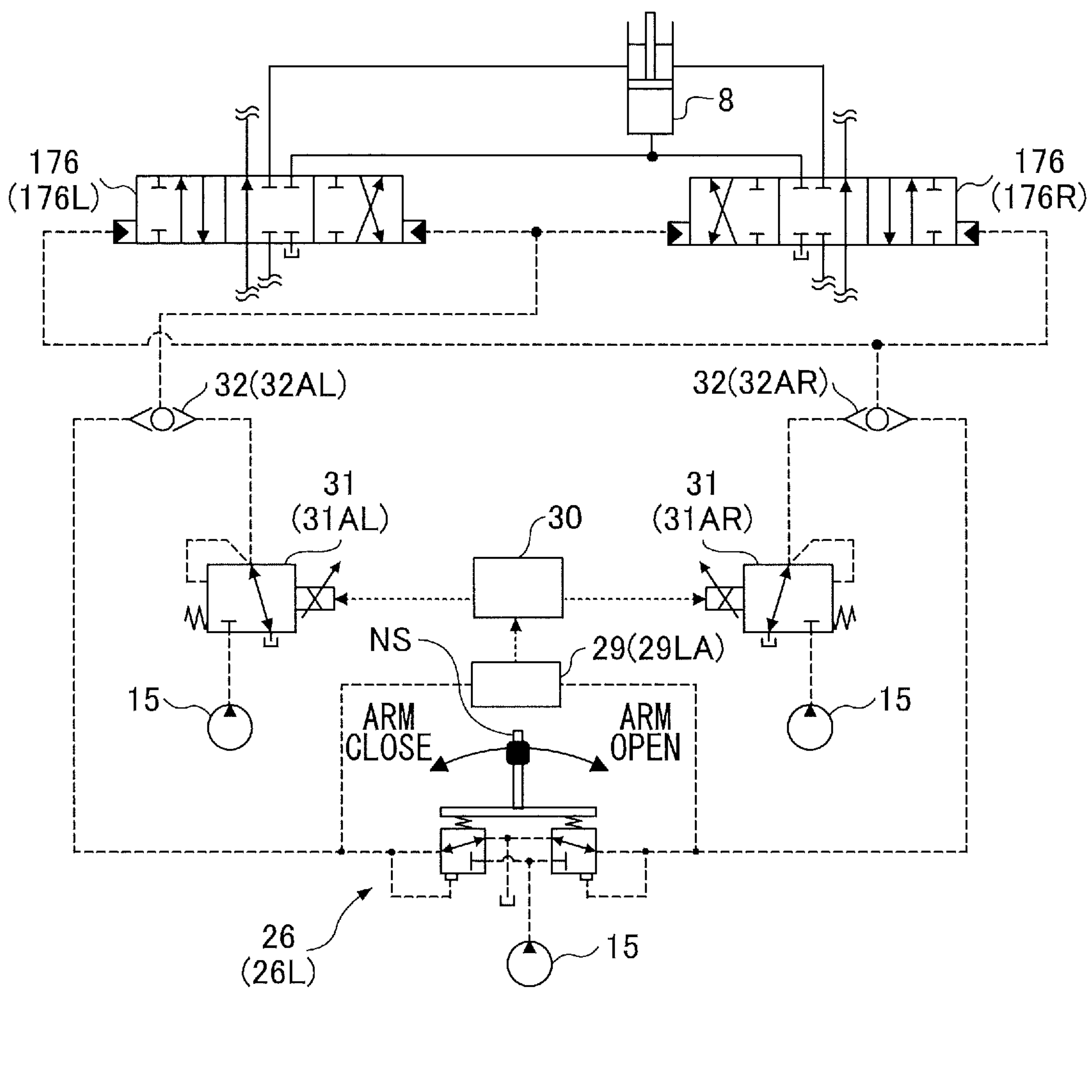

+X
+Y
-Y
-X
100
6
9
5
4
8
7
70
(70F)
1C
(1CL)
1C
(1CR)
D1
72
NS
26
30
10
D2
2A
71
S5
S4
70(70L)
70(70R)
2M(2ML)
2M(2MR)
3
11
70(70B)

FIG.3



19
(19L)
18
(18L)
30
8
17
18
(18R)
19
(19R)
30
176(176R)
176(176L)
7
175(175R)
9
2A
175(175L)
173
174
2M
(2ML)
2M
(2MR)
171
172
40(40L)
42(42L)
42(42R)
40(40R)
30
30
15
11
28(28L)
28(28R)
13(13L)
14
(14L)
14
(14R)
13(13R)
19L, 19R, 28L, 28R
30
FRONT
(ARM OPEN)
29
(29LA)
29
(29LB)
LEFT
(LEFT SWING)
RIGHT
(RIGHT SWING)
NS
26
(26L)
BACK
(ARM CLOSE)
FRONT
(BOOM DOWN)
29(29RA)
29(29RB)
LEFT
(BUCKET CLOSE)
RIGHT
(BUCKET OPEN)
26
(26R)
BACK
(BOOM UP)
FRONT
(MOVE FORWARD)
29(29DL)
26
(26DL)
BACK
(MOVE BACKWARD)
FRONT
(MOVE FORWARD)
29(29DR)
26(26DR)
BACK
(MOVE BACKWARD)

FIG.4A



8
176
(176L)
176
(176R)
32(32AL)
32(32AR)
31
(31AL)
31
(31AR)
30
NS
29(29LA)
15
15
ARM
CLOSE
ARM
OPEN
26
(26L)
15

FIG.4B

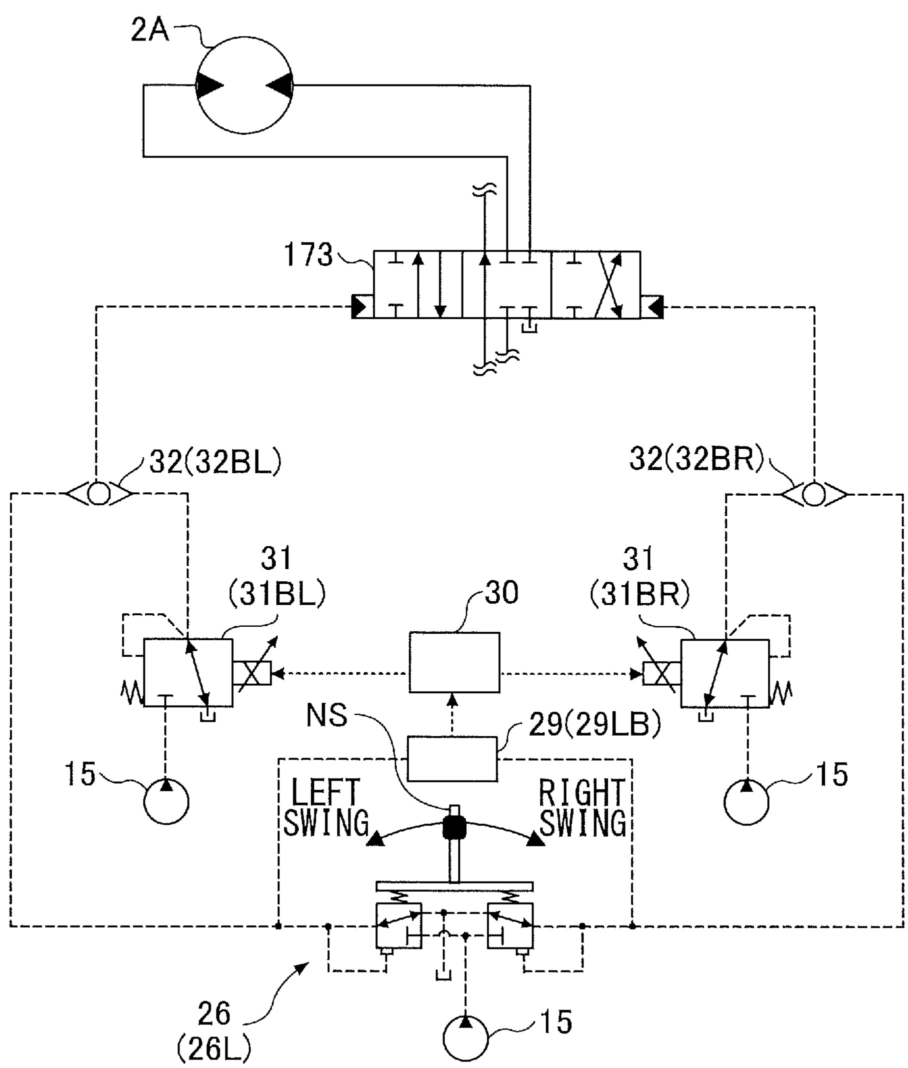

2A
173
32(32BL)
32(32BR)
31
(31BL)
30
31
(31BR)
NS
29(29LB)
15
LEFT
SWING
RIGHT
SWING
15
26
(26L)
15

FIG.4C

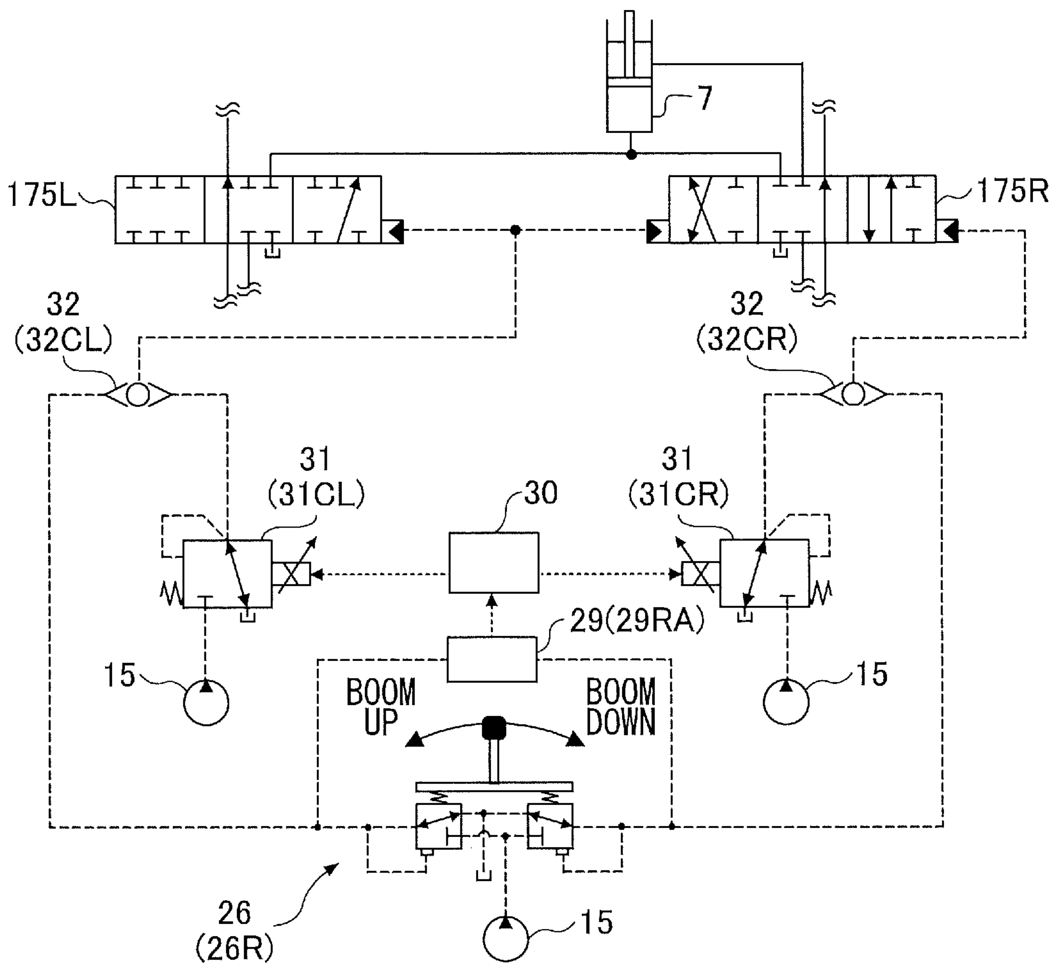

7
175L
175R
32
(32CL)
32
(32CR)
31
(31CL)
30
31
(31CR)
29(29RA)
15
15
BOOM
UP
BOOM
DOWN
26
(26R)
15

FIG.4D

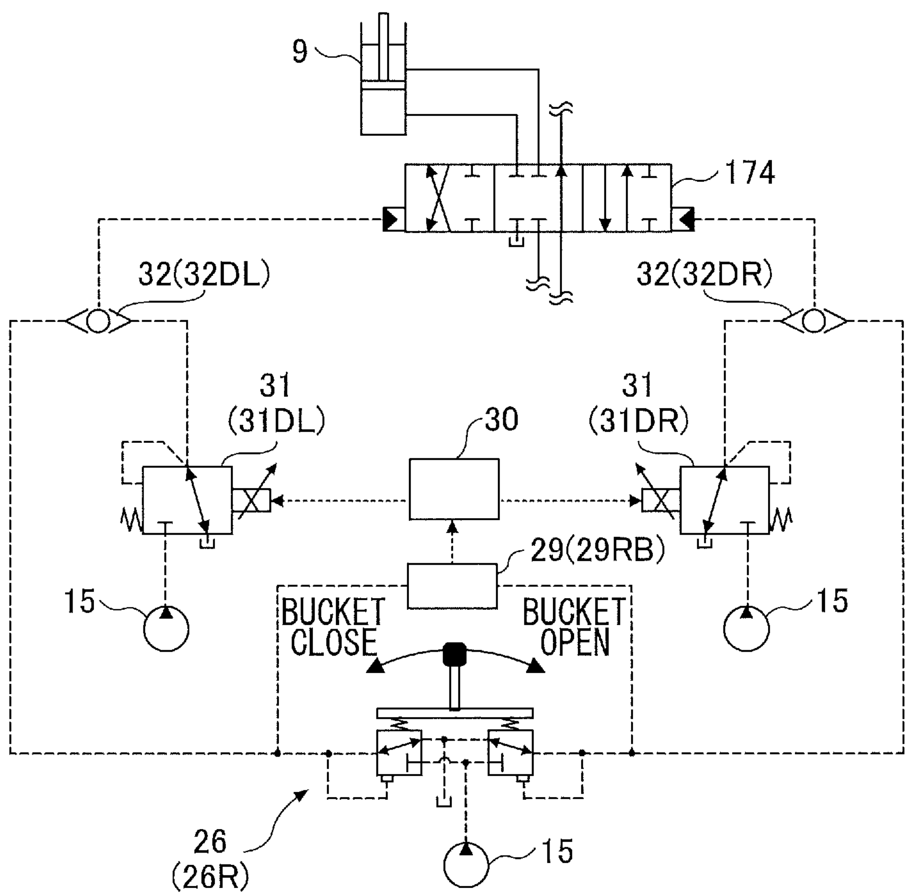

9
174
32(32DL)
32(32DR)
31
(31DL)
30
31
(31DR)
29(29RB)
15
BUCKET
CLOSE
BUCKET
OPEN
15
26
(26R)
15

FIG.5A

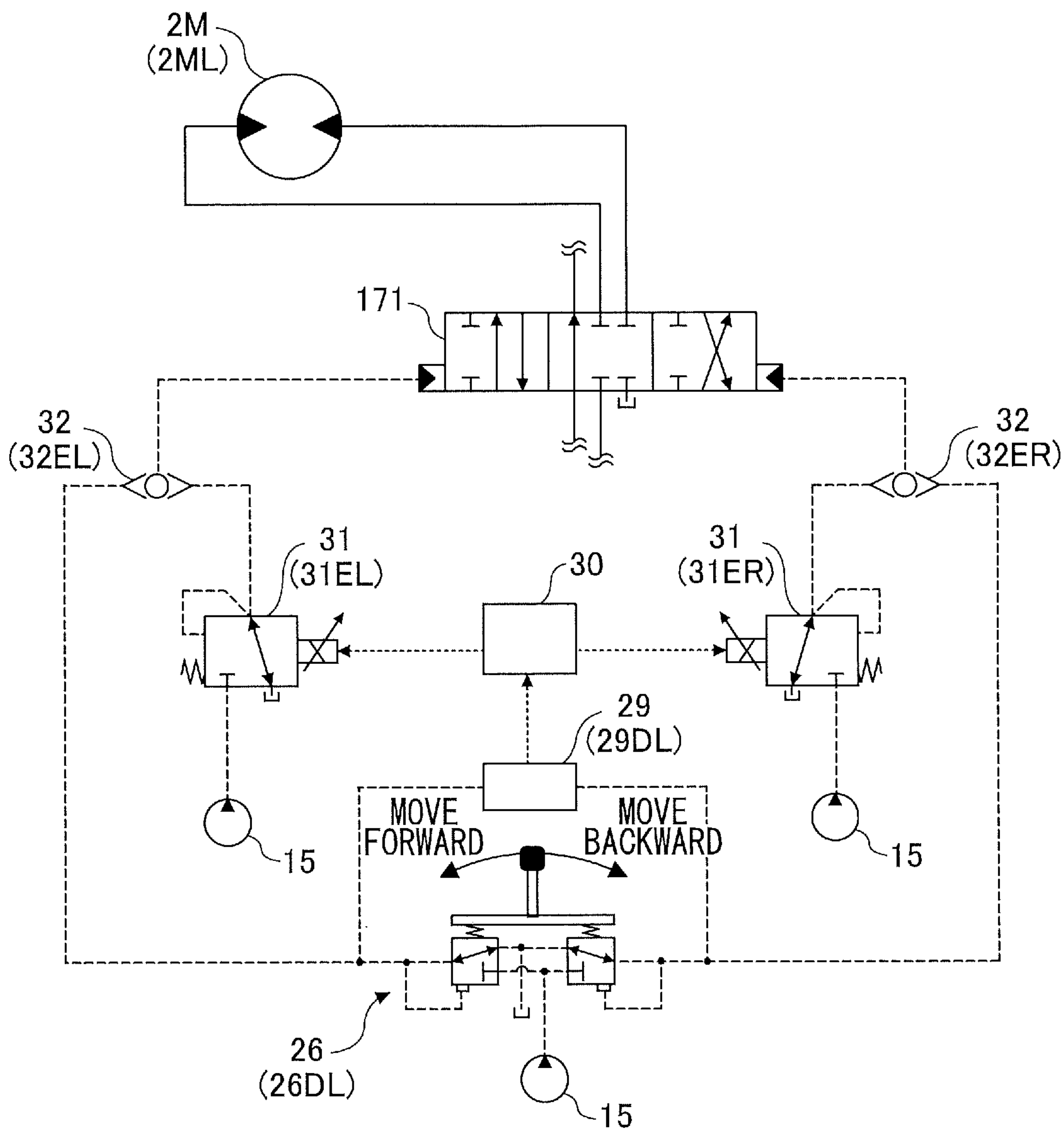
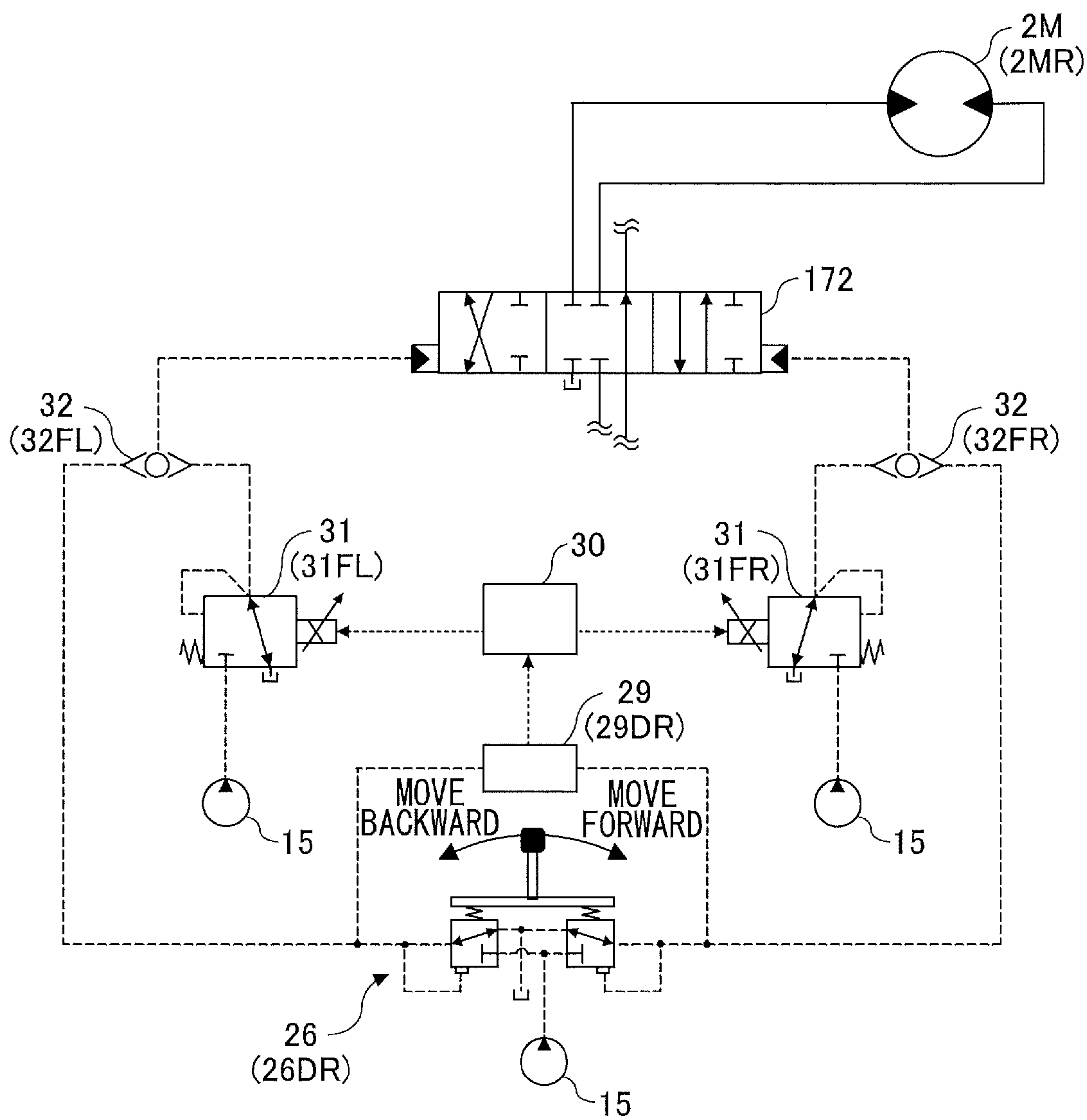

2M
(2ML)
171
32
(32EL)
32
(32ER)
31
(31EL)
30
31
(31ER)
29
(29DL)
MOVE
FORWARD
MOVE
BACKWARD
15
15
26
(26DL)
15

FIG.5B


2M
(2MR)
172
32
(32FL)
32
(32FR)
31
(31FL)
30
31
(31FR)
29
(29DR)
MOVE
BACKWARD
MOVE
FORWARD
15
15
26
(26DR)
15

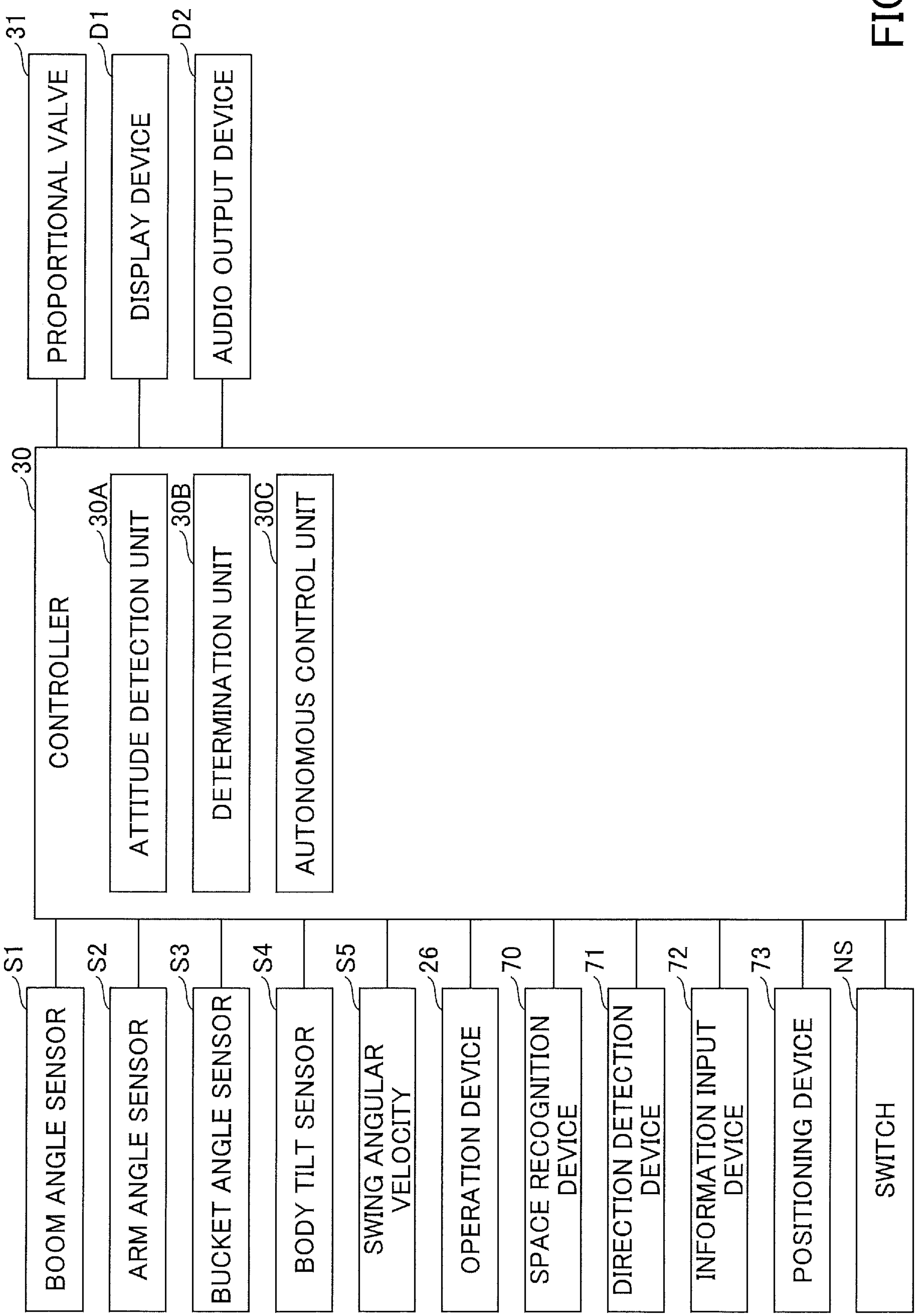

31
PROPORTIONAL VALVE
D1
DISPLAY DEVICE
D2
AUDIO OUTPUT DEVICE
30
CONTROLLER
30A
ATTITUDE DETECTION UNIT
30B
DETERMINATION UNIT
30C
AUTONOMOUS CONTROL UNIT
S1
BOOM ANGLE SENSOR
S2
ARM ANGLE SENSOR
S3
BUCKET ANGLE SENSOR
S4
BODY TILT SENSOR
S5
SWING ANGULAR VELOCITY
26
OPERATION DEVICE
70
SPACE RECOGNITION DEVICE
71
DIRECTION DETECTION DEVICE
72
INFORMATION INPUT DEVICE
73
POSITIONING DEVICE
NS
SWITCH

FIG.6

FIG. 7

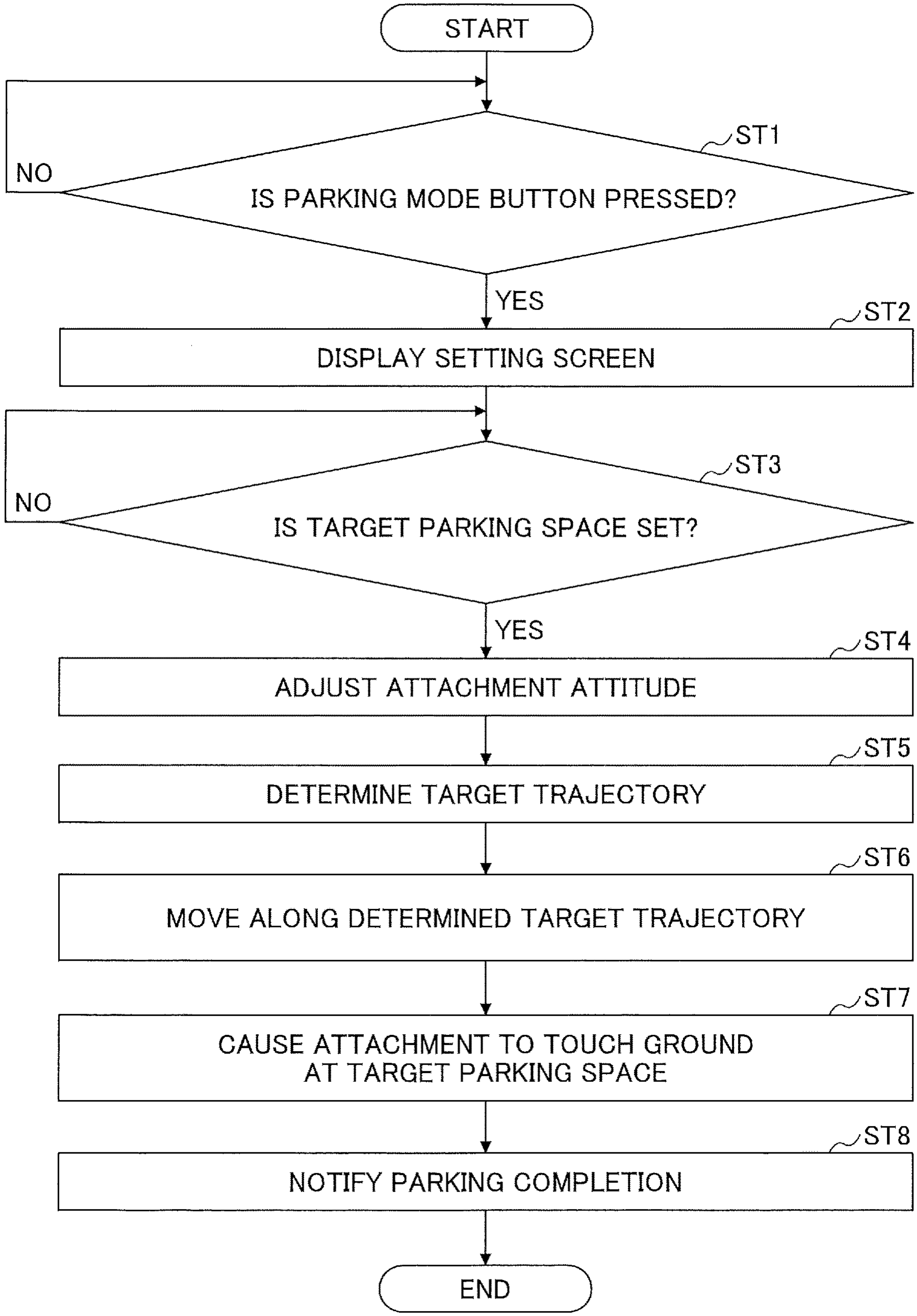

START
ST1
NO
IS PARKING MODE BUTTON PRESSED?
YES
ST2
DISPLAY SETTING SCREEN
ST3
NO
IS TARGET PARKING SPACE SET?
YES
ST4
ADJUST ATTACHMENT ATTITUDE
ST5
DETERMINE TARGET TRAJECTORY
ST6
MOVE ALONG DETERMINED TARGET TRAJECTORY
ST7
CAUSE ATTACHMENT TO TOUCH GROUND AT TARGET PARKING SPACE
ST8
NOTIFY PARKING COMPLETION
END

FIG.8

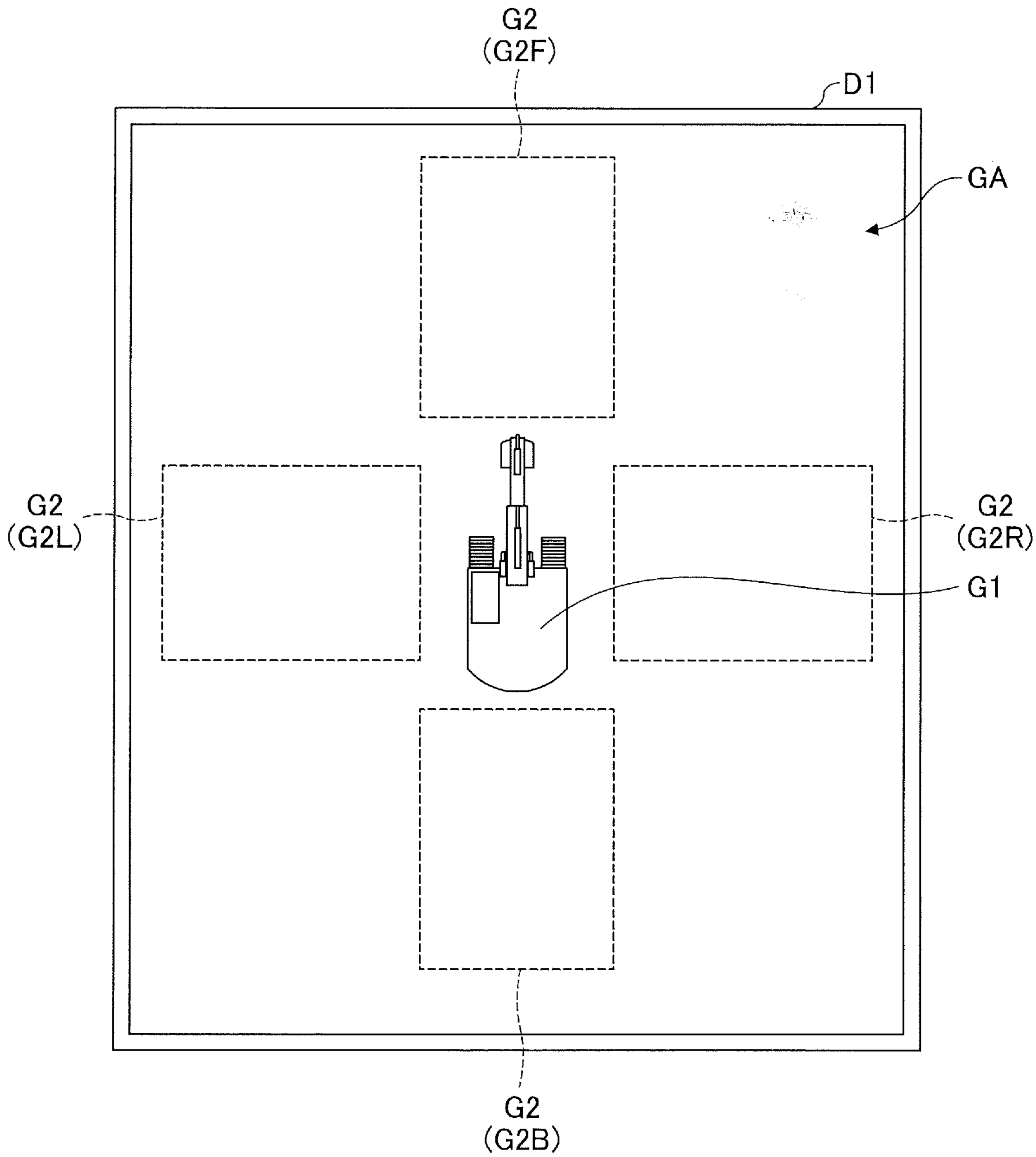


FIG.9

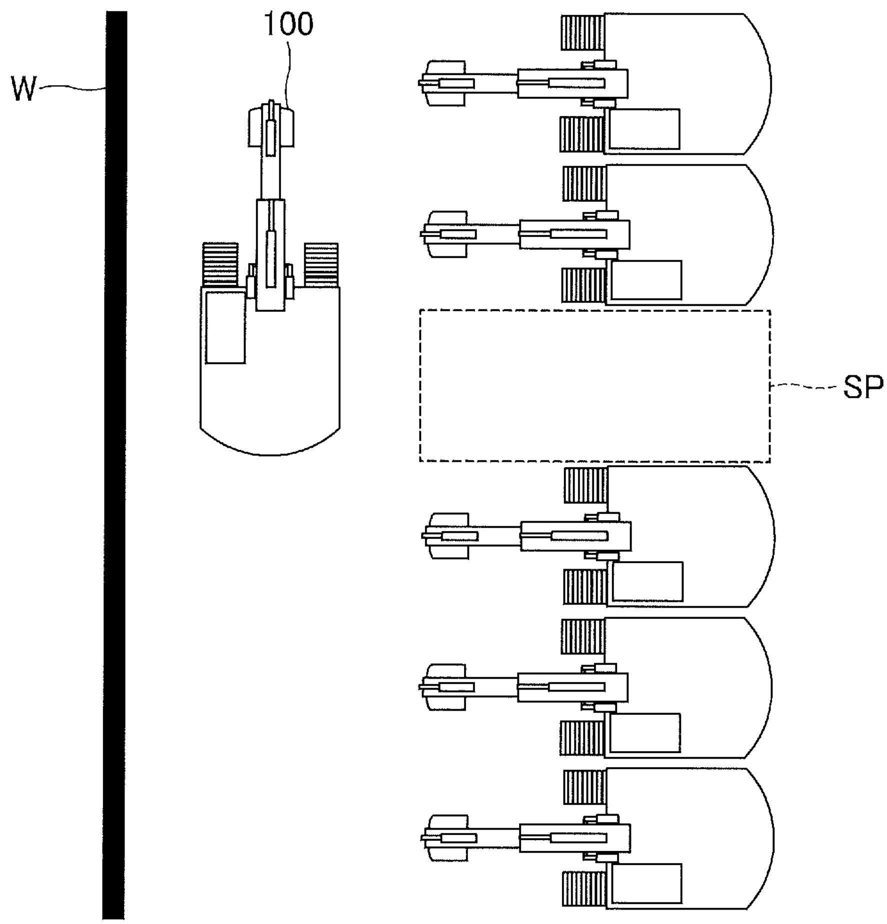


FIG.10

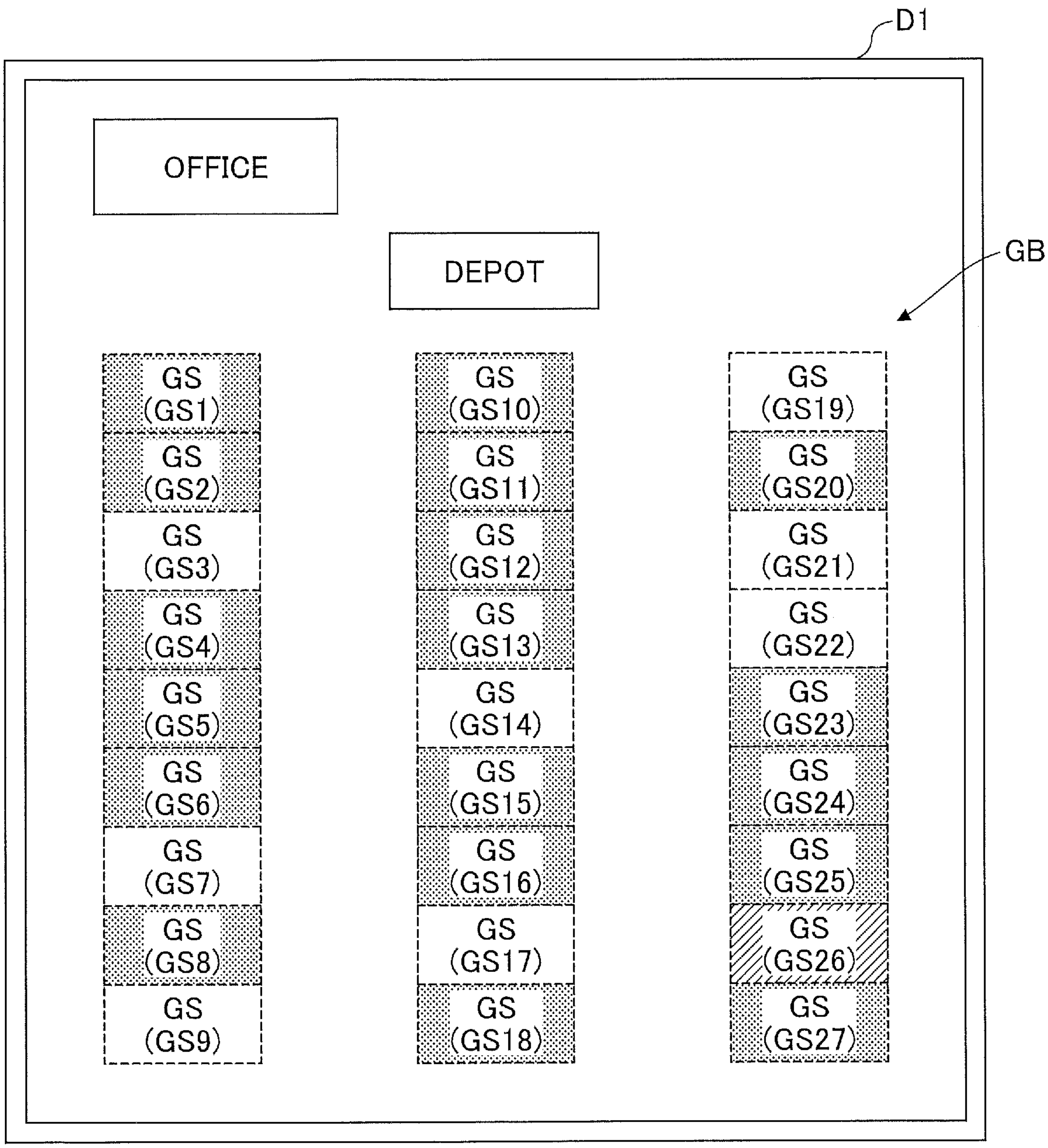

D1
OFFICE
DEPOT
GB
GS (GS1)
GS (GS2)
GS (GS3)
GS (GS4)
GS (GS5)
GS (GS6)
GS (GS7)
GS (GS8)
GS (GS9)
GS (GS10)
GS (GS11)
GS (GS12)
GS (GS13)
GS (GS14)
GS (GS15)
GS (GS16)
GS (GS17)
GS (GS18)
GS (GS19)
GS (GS20)
GS (GS21)
GS (GS22)
GS (GS23)
GS (GS24)
GS (GS25)
GS (GS26)
GS (GS27)

FIG.11

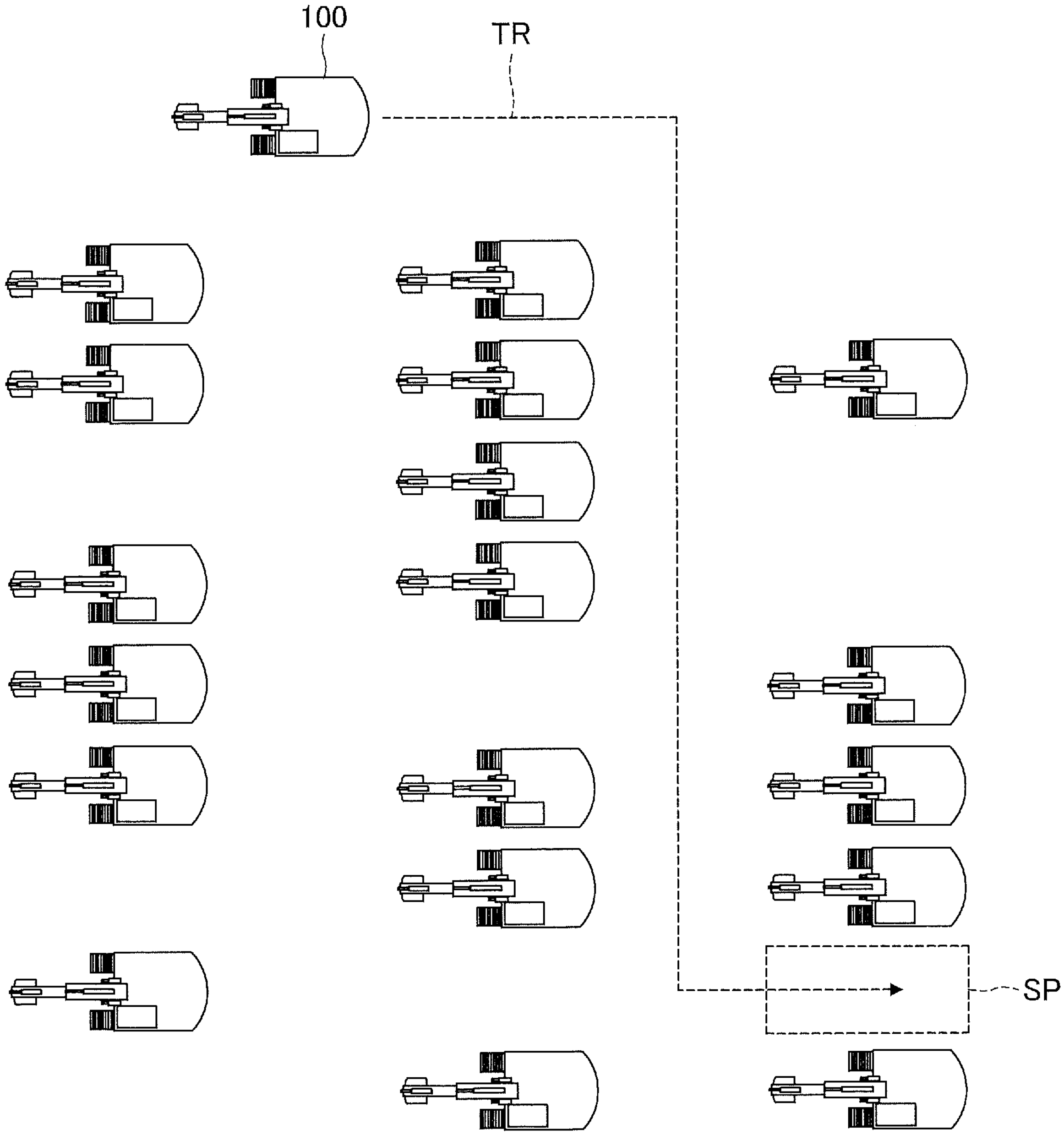


FIG.12

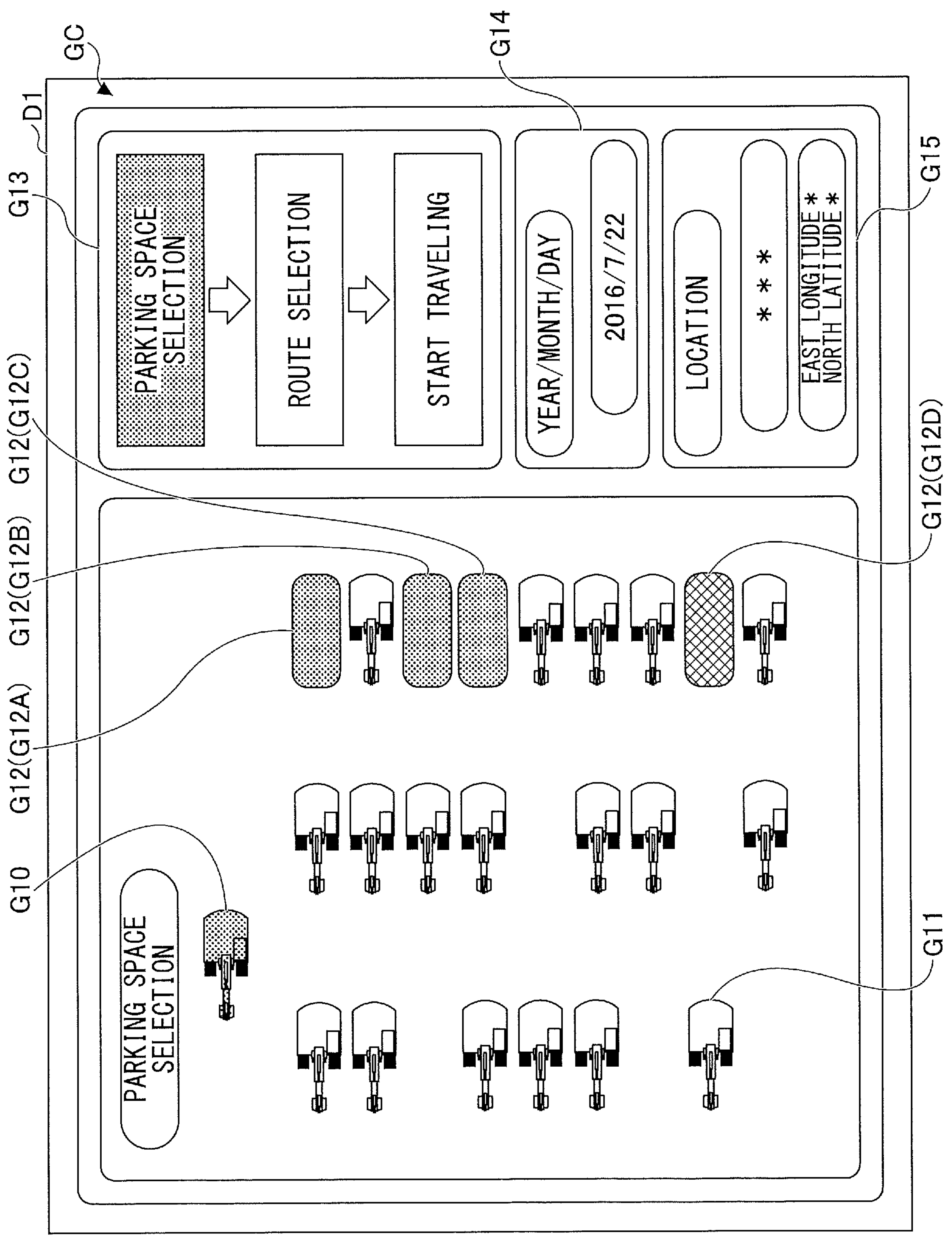

GC
D1
G13
G14
G15
PARKING SPACE SELECTION
ROUTE SELECTION
START TRAVELING
YEAR/MONTH/DAY
2016/7/22
LOCATION
* * *
EAST LONGITUDE **
NORTH LATITUDE **
G12(G12C)
G12(G12B)
G12(G12A)
G12(G12D)
G10
G11
PARKING SPACE SELECTION

FIG.13

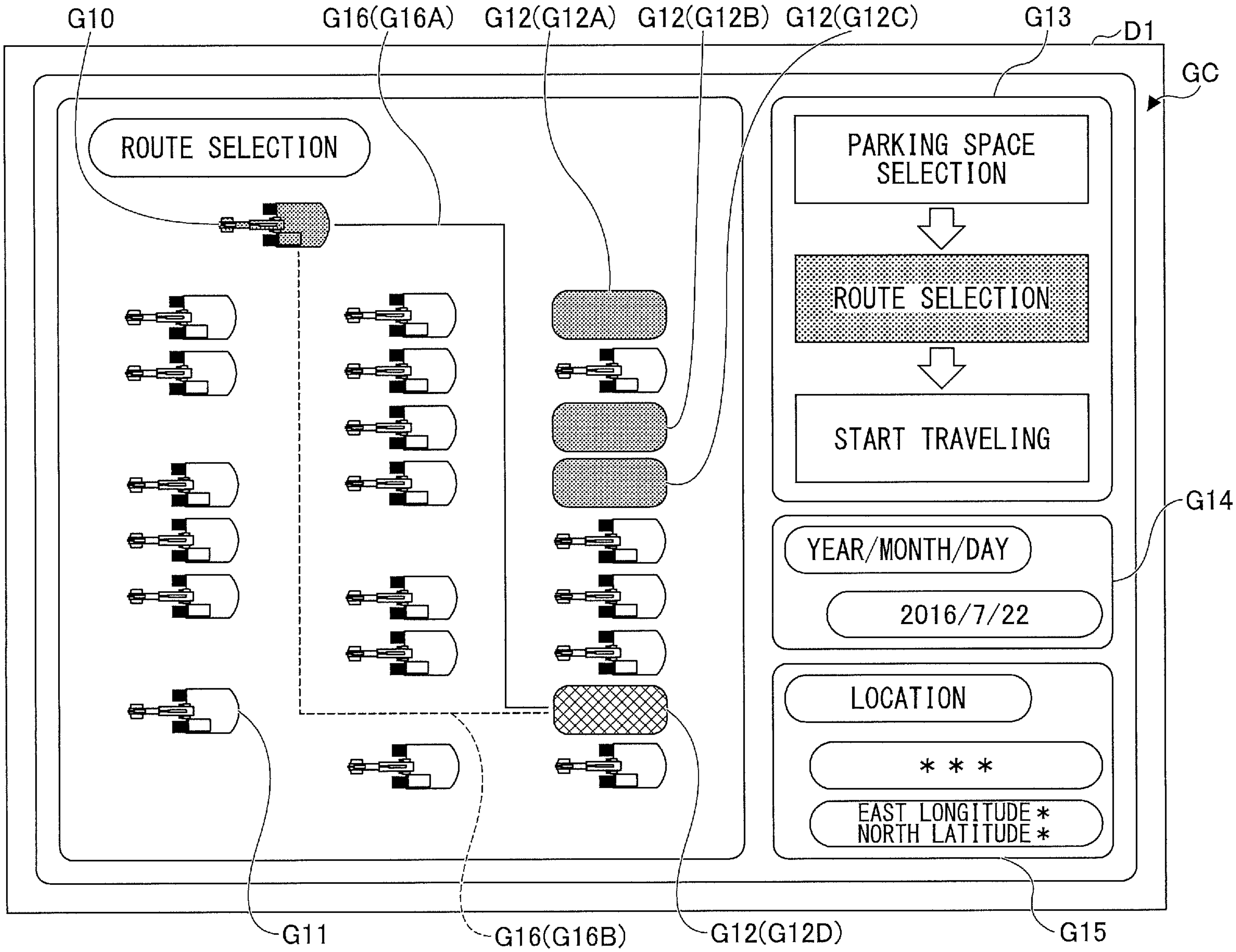
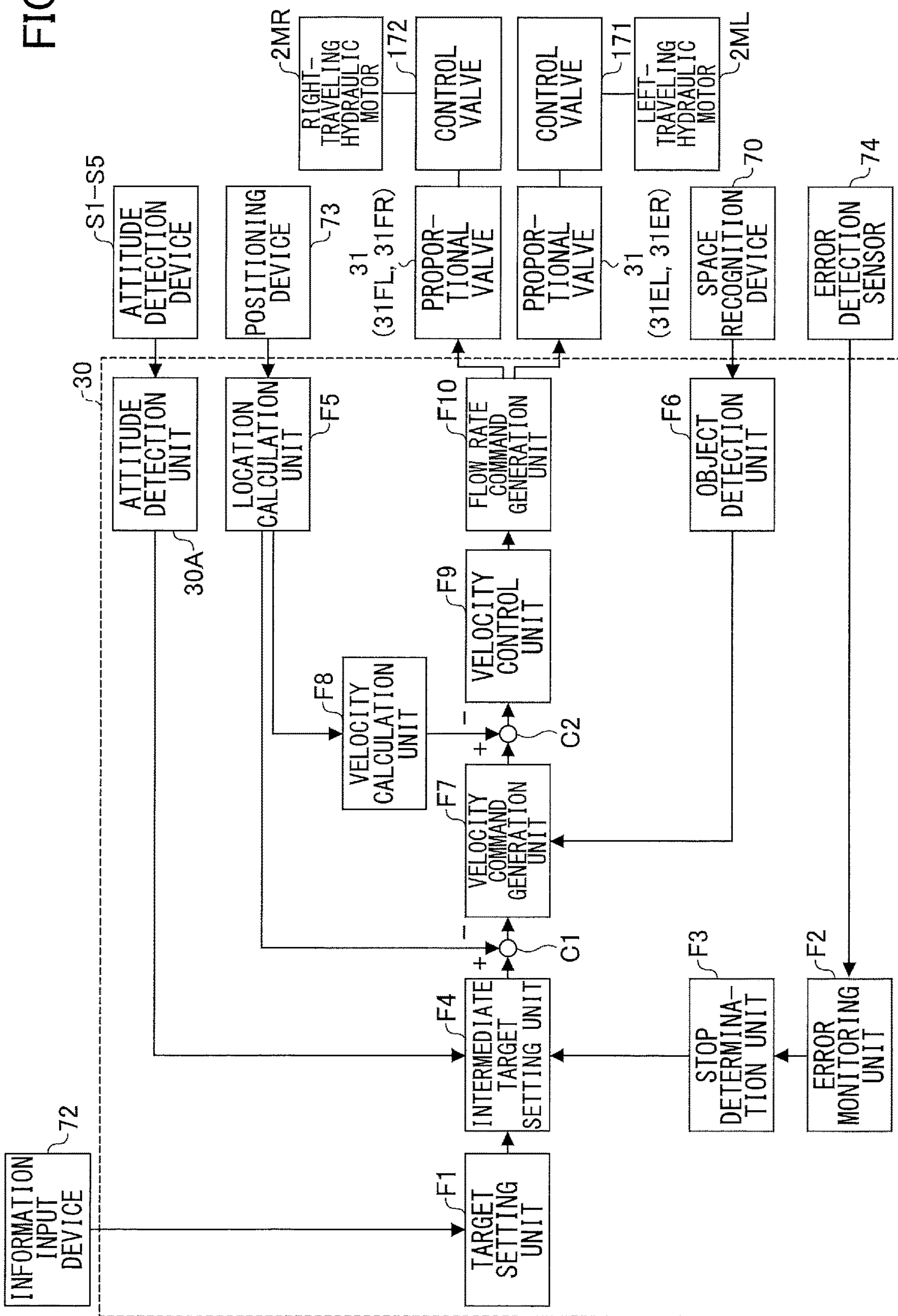

G10
G16(G16A)
G12(G12A)
G12(G12B)
G12(G12C)
G13
D1
GC
ROUTE SELECTION
PARKING SPACE SELECTION
ROUTE SELECTION
START TRAVELING
G14
YEAR/MONTH/DAY
2016/7/22
LOCATION
* * *
EAST LONGITUDE *
NORTH LATITUDE *
G11
G16(G16B)
G12(G12D)
G15

FIG.14



INFORMATION INPUT DEVICE
72
30
TARGET SETTING UNIT
F1
INTERMEDIATE TARGET SETTING UNIT
F4
STOP DETERMINA-TION UNIT
F3
ERROR MONITORING UNIT
F2
ATTITUDE DETECTION DEVICE
S1-S5
ATTITUDE DETECTION UNIT
30A
POSITIONING DEVICE
73
LOCATION CALCULATION UNIT
F5
C1
+
−
VELOCITY COMMAND GENERATION UNIT
F7
VELOCITY CALCULATION UNIT
F8
C2
VELOCITY CONTROL UNIT
F9
FLOW RATE COMMAND GENERATION UNIT
F10
PROPOR-TIONAL VALVE
31 (31FL, 31FR)
31 (31EL, 31ER)
CONTROL VALVE
172
171
RIGHT-TRAVELING HYDRAULIC MOTOR
2MR
LEFT-TRAVELING HYDRAULIC MOTOR
2ML
SPACE RECOGNITION DEVICE
70
OBJECT DETECTION UNIT
F6
ERROR DETECTION SENSOR
74

FIG.15

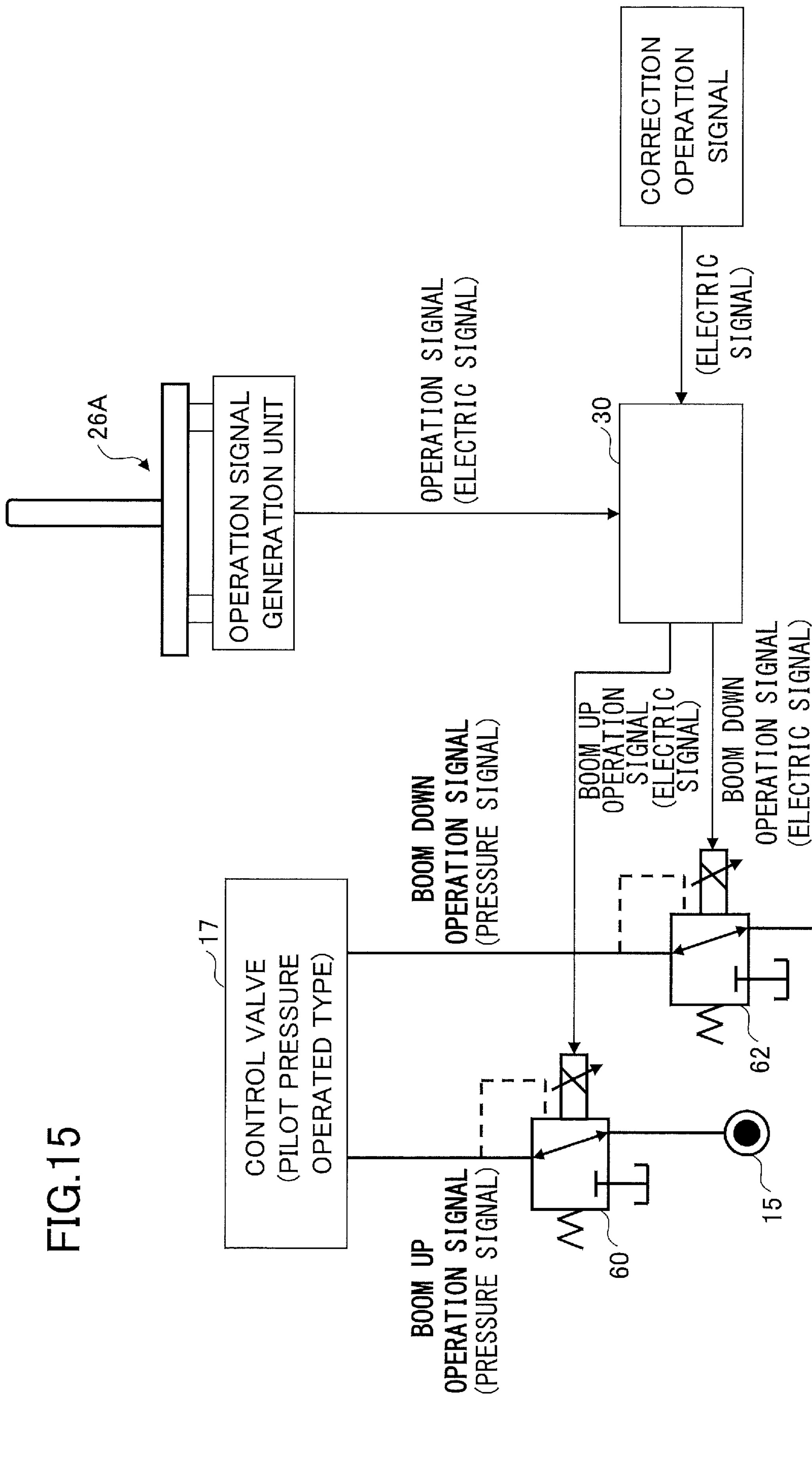
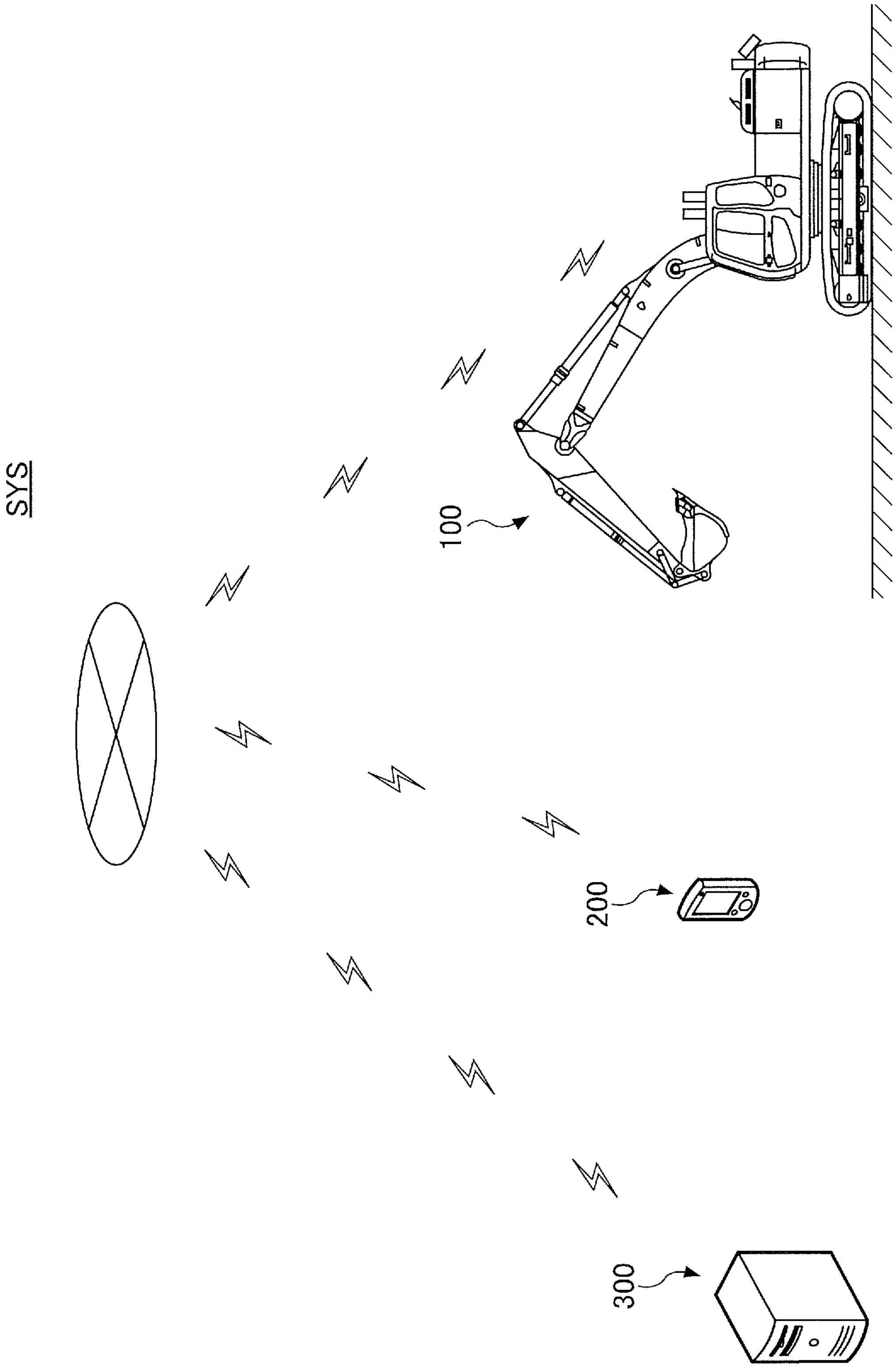

26A
OPERATION SIGNAL GENERATION UNIT
OPERATION SIGNAL (ELECTRIC SIGNAL)
CORRECTION OPERATION SIGNAL
(ELECTRIC SIGNAL)
30
BOOM UP OPERATION SIGNAL (ELECTRIC SIGNAL)
BOOM DOWN OPERATION SIGNAL (ELECTRIC SIGNAL)
17
CONTROL VALVE (PILOT PRESSURE OPERATED TYPE)
BOOM DOWN OPERATION SIGNAL (PRESSURE SIGNAL)
BOOM UP OPERATION SIGNAL (PRESSURE SIGNAL)
62
15
60
15

FIG.16



SHOVEL

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application is a continuation application of International Application No. PCT/JP2019/011889 filed on Mar. 20, 2019, which claims priority to Japanese Patent Application No. 2018-057172 filed on Mar. 23, 2018. The contents of these applications are incorporated herein by reference in their entirety.

TECHNICAL FIELD

[0002] The present invention relates to a shovel.

BACKGROUND ART

[0003] Conventionally, a shovel is known which automatically extends and contracts a boom cylinder, an arm cylinder, and a bucket cylinder, in accordance with a button operation of an operator, in order to cause a posture of an attachment to be suitable for parking.

SUMMARY OF THE INVENTION

Technical Problem

[0004] However, the above-described shovel is only capable of automatically changing a posture of an attachment, and is unable to automatically move the shovel to a parking location.

[0005] Therefore, it is desirable to provide a shovel that can assist in moving to a parking location.

Solution to Problem

[0006] According to an embodiment of the present invention, a shovel is provided. The shovel includes a lower-part traveling body, an upper-part swing body that is turnably mounted on the lower-part traveling body, a traveling actuator that drives the lower-part traveling body, a space recognition device that is provided in the upper-part swinging body, an orientation detection device that detects information related to a relative relation between an orientation of the upper-part swing body and an orientation of the lower-part traveling body, and a control device that is provided in the upper swinging body, wherein the control device causes the traveling actuator to operate, based on an output of the space recognition device and an output of the orientation detection device.

Advantageous Effects of Invention

[0007] According to the above solution, a shovel is provided which can assist in moving to a parking location.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. **1** is a side view of a shovel according to an embodiment of the present invention.

[0009] FIG. **2** is a top view of the shovel of FIG. **1**.

[0010] FIG. **3** is a diagram illustrating a configuration example of a hydraulic system installed in the shovel of FIG. **1**.

[0011] FIG. **4**A is a diagram illustrating a part of the hydraulic system related to an operation of an arm cylinder.

[0012] FIG. **4**B is a diagram illustrating a part of the hydraulic system related to an operation of a hydraulic swing motor.

[0013] FIG. **4**C is a diagram illustrating a part of the hydraulic system related to an operation of a boom cylinder.

[0014] FIG. **4**D is a drawing illustrating a part of the hydraulic system related to an operation of a bucket cylinder.

[0015] FIG. **5**A is a diagram illustrating a part of the hydraulic system related to an operation of a left hydraulic traveling motor.

[0016] FIG. **5**B is a diagram illustrating a part of the hydraulic system related to an operation of a right hydraulic traveling motor.

[0017] FIG. **6** is a functional block diagram illustrating a configuration example of a controller.

[0018] FIG. **7** is a flowchart illustrating an example of a parking process.

[0019] FIG. **8** is a drawing illustrating an example of a parking space selection screen.

[0020] FIG. **9** is a top view of an example of an actual parking lot.

[0021] FIG. **10** is a drawing illustrating another example of a parking space selection screen.

[0022] FIG. **11** is a top view of another example of an actual parking lot.

[0023] FIG. **12** is a drawing illustrating a yet another example of a parking space selection screen.

[0024] FIG. **13** is a drawing illustrating a yet another example of a parking space selection screen.

[0025] FIG. **14** is a functional block diagram illustrating a configuration example of another controller.

[0026] FIG. **15** is a diagram illustrating a configuration example of an electronically-controlled operation system.

[0027] FIG. **16** is a schematic diagram illustrating a configuration example of a shovel management system.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0028] First, referring to FIG. **1** and FIG. **2**, a shovel **100** as an excavator according to an embodiment of the present invention will be described. FIG. **1** is a side view of the shovel **100**, and FIG. **2** is a top view of the shovel **100**.

[0029] According to an embodiment of the present invention, a lower-part traveling body **1** of the shovel **100** includes a crawler **1**C. The crawler **1**C is driven by a hydraulic traveling motor **2**M as a traveling actuator installed in the lower-part traveling body **1**. Specifically, the crawler **1**C includes a left crawler **1**CL and a right crawler **1**CR. The left crawler **1**CL is driven by a left hydraulic traveling motor **2**ML, and the right crawler **1**CR is driven by a right hydraulic traveling motor **2**MR.

[0030] An upper-part swing body **3** is turnably mounted on the lower-part traveling body **1** via a swing mechanism **2**. The swing mechanism **2** is driven by a hydraulic swing motor **2**A as a swing actuator installed in the upper-part swing body **3**. It should be noted, however, the swing actuator may be a swing motor generator as an electronic actuator.

[0031] A boom **4** is attached to the upper-part swing body **3**. An arm **5** is attached to a top end of the boom **4**, and a bucket **6** as an end attachment is attached to a top end of the arm **5**. The boom **4**, the arm **5**, and the bucket **6** form an excavating attachment AT as an example of an attachment.

The boom **4** is driven by a boom cylinder **7**, the arm **5** is driven by an arm cylinder **8**, and the bucket **6** is driven by a bucket cylinder **9**.

[0032] The boom cylinder **7**, the arm cylinder **8**, and the bucket cylinder **9** form an attachment actuator.

[0033] The boom **4** is rotatably supported to rotate up and down with respect to the upper-part swing body **3**. Further, a boom angle sensor S**1** is attached to the boom **4**. The boom angle sensor S**1** is capable of detecting a boom angle θ**1** as a rotational angle of the boom **4**. The boom angle θ**1** is, for example, an increased angle from a state in which the boom **4** is lowered most. Therefore, the boom angle θ**1** becomes a maximum when the boom **4** is lifted most.

[0034] The arm **5** is rotatably supported to rotate with respect to the boom **4**. Further, an arm angle sensor S**2** is attached to the arm **5**. The arm angle sensor S**2** is capable of detecting an arm angle θ**2** as a rotational angle of the arm **5**. The arm angle θ**2** is, for example, a opened angle from a state in which the arm **5** is closed most. Therefore, the arm angle θ**2** becomes a maximum when the arm **5** is opened most.

[0035] The bucket **6** is rotatably supported to rotate with respect to the arm **5**. Further, a bucket angle sensor S**3** is attached to the bucket **6**. The bucket angle sensor S**3** is capable of detecting a bucket angle θ**3** as a rotational angle of the bucket **6**. The bucket angle θ**3** is an opened angle from a state in which the bucket **6** is closed most. Therefore, the bucket angle θ**3** becomes a maximum when the bucket **6** is opened most.

[0036] In an embodiment of the present invention in FIG. **1**, each of the boom angle sensor S**1**, the arm angle sensor S**2**, and the bucket angle sensor S**3** is formed by a combination of an acceleration sensor and a gyro sensor. It should be noted, however, that at least one of the boom angle sensor S**1**, the arm angle sensor S**2**, and the bucket angle sensor S**3** may be formed by an acceleration sensor alone. Furthermore, the boom angle sensor S**1** may be a stroke sensor attached to the boom cylinder **7**, or may be a rotary encoder, a potentiometer, an inertia measurement device, or the like. The arm angle sensor S**2** and the bucket angle sensor S**3** are the same as the boom angle sensor S**1**.

[0037] A cabin **10** as an operator's cab is provided in the upper-part swing body **3** and a power source such as an engine **11** is installed in the upper-part swing body **3**. Further, a space recognition device **70**, an orientation detection device **71**, a positioning device **73**, a device body inclination sensor S**4**, a swing angular velocity sensor S**5**, etc., are attached to the upper-part swing body **3**. An operation device **26**, a controller **30**, an information input device **72**, a display device D**1**, a sound output device D**2**, etc., are provided in the cabin **10**. It should be noted that, in this specification, for the sake of convenience, a side on which the excavating attachment AT is attached to in the upper-part swing body **3** is referred to as a front side, and a side on which a counter weight is attached to is referred to as a rear side.

[0038] The space recognition device **70** is configured to recognize an object existing in a three-dimensional space surrounding the shovel **100**. Further, the space recognition device **70** is configured to calculate a distance from the space recognition device **70** or the shovel **100** to the recognized object. The space recognition device **70** is, for example, an ultrasonic sensor, a millimeter wave radar, a monocular camera, a stereo camera, a LIDAR, a distance image sensor, an infrared sensor, or the like. In an embodiment of the present invention, the space recognition device **70** includes: a front side sensor **70**F attached to a front end of an upper surface of the cabin **10**; a rear side sensor **70**B attached to a rear end of the upper surface of the upper-part swing body **3**; a left side sensor **70**L attached to a left end of the upper surface of the upper-part swing body **3**; and a right side sensor **70**R attached to a right end of the upper surface of the upper-part swing body **3**. An upper side sensor that recognizes an object existing in an upper space of the upper-part swing body **3** may be attached to the shovel **100**.

[0039] The space recognition device **70** may be configured to detect an object existing around the shovel **100**. The object is, for example, a person, an animal, a vehicle (such as a dump track), work equipment, a construction machine, a building, a wire, a fence, a hole, or the like. In a case where the space recognition device **70** is configured to detect a person as an object, the space recognition device **70** is configured to distinguish between a person and an object that is not a person. Further, The space recognition device **70** may be configured to identify a type of an object.

[0040] The space recognition device **70** may be configured to recognize a condition of a road surface. Specifically, the space recognition device **70** may be configured to, for example, identify a type of an object existing on the road surface. The type of the object existing on the road surface is, for example, a tobacco, a can, a pet bottle, a stone, or the like.

[0041] The orientation detection device **71** is configured to detect information related to a relative relationship between an orientation of the upper-part swing body **3** and an orientation of the lower-part traveling body **1**. The orientation detection device **71** may be formed by, for example, a combination of geomagnetic sensor attached to the lower-part traveling body **1** and a geomagnetic sensor attached to the upper-part swing body **3**. Alternatively, the orientation detection device **71** may be formed by a combination of a GNSS receiver attached to the lower-part traveling body **1** and a GNSS receiver attached to the upper-part swing body **3**. The orientation detection device **71** may be a rotary encoder, a rotary position sensor, or the like. In a case where the upper-part swing body **3** is driven to swing by a swing motor generator, the orientation detection device **71** may be formed by a resolver. The orientation detection device **71** may be attached to, for example, a center joint that is provided in relation to the swing mechanism **2** that realizes a relative rotation between the lower-part traveling body **1** and the upper-part swing body **3**.

[0042] The orientation detection device **71** may be formed by a camera attached to the upper-part swing body **3**. In this case, the orientation detection device **71** applies a known image processing to an image (input image) captured by the camera attached to the upper-part swing body **3** and detects an image of the lower-part traveling body **1** included in the input image Further, the orientation detection device **71** identifies a longitudinal direction of the lower-part traveling body **1** by detecting the image of the lower-part traveling body **1** using a known image recognition technology. Further, the orientation detection device **71** derives an angle formed between a front-rear axis direction of the upper-part swing body **3** and the longitudinal direction of the lower-part traveling body **1**. The front-rear axis direction of the upper-part swing body **3** is derived from a position to which the camera is attached. Because the crawler **1**C protrudes from the upper-part swing body **3**, the orientation detection device **71** can determine the longitudinal direction of the lower-part traveling body **1** by detecting an image of the crawler **1**C. In this case, the orientation detection device **71** may be integrated with the controller **30**.

[0043] The information input device **72** is configured in such a way that an operator of the shovel can input information to the controller **30**. In an embodiment of the present invention, the information input device **72** is a switch panel provided close to a display unit of the display device D**1**. It should be noted, however, that the information input device **72** may be a touch panel provided on the display unit of the display device D**1**, or may be a sound input device such as a microphone provided in the cabin **10**.

[0044] The positioning device **73** is configured to measure a location of the upper-part swing body **3**. In an embodiment of the present invention, the positioning device **73** is a GNSS receiver, detects a location of the upper-part swing body **3**, and outputs a detected value to the controller **30**. The positioning device **73** may be a GNSS compass. In this case, the positioning device **73** can detect a location and an orientation of the upper-part swing body **3**.

[0045] The device body inclination sensor S**4** is configured to detect an inclination of the upper-part swing body **3** with respect to a predetermined plane. In an embodiment of the present invention, the device body inclination sensor S**4** is an acceleration sensor that detects: an inclination angel (roll angle) around the front-rear axis of the upper-part swing body **3** with respect to a horizontal plane; and an inclination angle (pitch angle) around the left-right axis. The front-rear axis and the left-right axis of the upper-part swing body **3** are, for example, perpendicular to each other, and pass through a shovel center point that is a point on a swing axis of the shovel **100**. The device body inclination sensor S**4** may be a combination of an acceleration sensor and a gyro sensor.

[0046] The swing angular velocity sensor S**5** detects a swing angular velocity of the upper-part swing body **3**. In an embodiment of the present invention, the swing angular velocity sensor S**5** is a gyro sensor. The swing angular velocity sensor S**5** may be a resolver, a rotary encoder, or the like. The swing angular velocity sensor S**5** may detect a swing velocity. The swing velocity may be calculated from the swing angular velocity.

[0047] Hereinafter, at least one of the boom angle sensor S**1**, the arm angle sensor S**2**, the bucket angle sensor S**3**, the device body inclination sensor S**4**, and the swing angular velocity sensor S**5** is referred to as a posture detection device. The posture of the excavating attachment AT is detected based on, for example, respective outputs of the boom angle sensor S**1**, the arm angle sensor S**2**, the bucket angle sensor S**3**,

[0048] The display device D**1** is configured to display various information items. In an embodiment of the present invention, the display device D**1** is a liquid crystal display provided in the cabin **10**. It should be noted, however, that the display device D**1** may be a display of a mobile terminal such as a smart phone.

[0049] The sound output device D**2** is configured to output sound. The sound output device D**2** includes at least one of: a device that outputs sound to an operator in the cabin **10**; and a device that outputs sound to workers outside the cabin **10**. The sound output device D**2** may be a speaker of a mobile terminal.

[0050] The operation device **26** is a device used by an operator for operating an actuator. The operation device **26** includes, for example, an operation lever and an operation pedal. The actuator includes at least one of a hydraulic actuator and an electronic actuator.

[0051] The controller **30** is a control device for controlling the shovel **100**. In an embodiment of the present invention, the controller **30** is formed by a computer including a CPU, a RAM, a NVRAM, a ROM, etc. Further, the controller **30** reads programs corresponding to respective functions from the ROM, loads the programs to the RAM, and causes the CPU to execute corresponding processes. The respective functions include, for example: a machine guidance function for guiding manual operations of the shovel **100** by an operator; and a machine control function for assisting the manual operations of the shovel **100** by an operator, or for causing the shovel **100** to operate automatically or autonomously.

[0052] Next, referring to FIG. **3**, a configuration example of a hydraulic system installed in the shovel **100** will be described. FIG. **3** is a diagram illustrating a configuration example of a hydraulic system installed in the shovel **100**. In FIG. **3**, a mechanical power transmission system, hydraulic oil lines, pilot lines, and an electrical control system are indicated by double lines, solid lines, dashed lines, and dotted lines, respectively.

[0053] The hydraulic system of the shovel **100** mainly includes an engine **11**, a regulator **13**, a main pump **14**, a pilot pump **15**, a control valve **17**, the operation device **26**, a discharge pressure sensor **28**, an operation pressure sensor **29**, the controller **30**, etc.

[0054] In FIG. **3**, the hydraulic system is configured to circulate the hydraulic oil from a main pump **14** driven by the engine **11** to the hydraulic oil tank via a center bypass line **40** or a parallel line **42**.

[0055] The engine **11** is a drive source of the shovel **100**. In an embodiment of the present invention, the engine **11** is a diesel engine that operates to maintain a predetermined speed. An output shaft of the engine **11** is coupled to respective input shafts of the main pump **14** and the pilot pump **15**.

[0056] The main pump **14** is configured to supply the hydraulic oil to the control valve **17** via the hydraulic oil line. In an embodiment of the present invention, the main pump **14** is a swash plate variable displacement hydraulic pump.

[0057] The regulator **13** is configured to control discharge amount of the main pump **14**. In an embodiment of the present invention, the regulator **13** controls the discharge amount (displacement volume) of the main pump **14** by adjusting a swash plate tilting angle of the main pump **14** in response to a control command from the controller **30**.

[0058] The pilot pump **15** is configured to supply the hydraulic oil to hydraulic control devices including the operation device **26** via the pilot line. In an embodiment of the present invention, the pilot pump **15** is a fixed capacitive hydraulic pump. It should be noted, however, that the pilot pump **15** may be omitted. In this case, the function performed by the pilot pump **15** may be performed by the main pump **14**. In other words, the main pump **14** may have a function of, in addition to the function of supplying hydraulic oil to the control valve **17**, supplying hydraulic oil to the operation device **26**, etc., after reducing the hydraulic oil pressure by an aperture, or the like.

[0059] The control valve **17** is a hydraulic control device that control the hydraulic system in the shovel **100**. In an embodiment of the present invention, the control valve **17** includes control valves **171** to **176**. The control valve **175** includes a control valve **175**L and a control valve **175**R, and the control valve **176** includes a control valve **176**L and a control valve **176**R. The control valve **17** is configured to selectively supply hydraulic oil that is discharged by the main pump **14** to one or more hydraulic actuators through control valves **171** to **176**. The control valves **171** to **176** control, for example: a flow rate of hydraulic oil that flows from the main pump **14** to the hydraulic actuators; and a flow rate of hydraulic oil that flows from the hydraulic actuators to a hydraulic oil tank. The hydraulic actuators include the boom cylinder **7**, the arm cylinder **8**, the bucket cylinder **9**, the left hydraulic traveling motor **2**ML, the right hydraulic traveling motor **2**MR, and the hydraulic swing motor **2**A.

[0060] The operation device **26** is configured to supply the hydraulic oil that is discharged by the pilot pump **15** to a pilot port of a corresponding control valve in the control valve **17** via the pilot line. A pressure (pilot pressure) of the hydraulic oil, which is supplied to each of the pilot ports, is a pressure in accordance with an operation direction and an operation amount of the operation device **26** corresponding to each of the hydraulic actuators. It should be noted, however, that the operation device **26** may not be of a pilot pressure type as described above, but may be of an electric control type. In this case, the control valve in the control valve **17** may be an electromagnetic solenoid spool valve.

[0061] The discharge pressure sensor **28** is configured to detect a discharge pressure of the main pump **14**. In an embodiment of the present invention, the discharge pressure sensor **28** outputs a detected value to the controller **30**.

[0062] The operation pressure sensor **29** is configured to detect an operated content of the operation device **26** by an operator. In an embodiment of the present invention, the operation pressure sensor **29** detects, in the form of a pressure (operation pressure), an operation direction and an operation amount of the operation device **26** corresponding to each of the actuators, and outputs detected values to the controller **30**., The operated content of the operation device **26** may be detected by using a sensor other than the operation pressure sensor.

[0063] The main pump **14** includes a left main pump **14**L and a right main pump **14**R. Further, the left main pump **14**L circulates the hydraulic oil to the hydraulic oil tank via a left center bypass line **40**L or a left parallel line **42**L. The right main pump **14**R circulates the hydraulic oil to the hydraulic oil tank via a right center bypass line **40**R or a right parallel line **42**R.

[0064] The left center bypass line **40**L is a hydraulic oil line that passes control valves **171**, **173**, **175**L and **176**L provided in the control valve **17**. The right center bypass line **40**R is a hydraulic oil line that passes control valves **172**, **174**, **175**R and **176**R provided in the control valve **17**.

[0065] The control valve **171** is a spool valve that switches the flow of the hydraulic oil in order to:

[0066] supply hydraulic oil, which is discharged from the left main pump **14**L, to the left hydraulic traveling motor **2**ML; and discharge hydraulic oil, which is discharged from the left hydraulic traveling motor **2**ML, to the hydraulic oil tank.

[0067] The control valve **172** is a spool valve that switches the flow of the hydraulic oil in order to: supply hydraulic oil, which is discharged from the right main pump **14**R, to the right hydraulic traveling motor **2**MR; and discharge hydraulic oil, which is discharged from the right hydraulic traveling motor **2**MR, to the hydraulic oil tank.

[0068] The control valve **173** is a spool valve that switches the flow of the hydraulic oil in order to: supply hydraulic oil, which is discharged from the left main pump **14**L, to the hydraulic swing motor **2**A; and discharge hydraulic oil, which is discharged from the hydraulic swing motor **2**A, to the hydraulic oil tank.

[0069] The control valve **174** is a spool valve that switches the flow of the hydraulic oil in order to: supply hydraulic oil, which is discharged from the right main pump **14**R, to the bucket cylinder **9**; and discharge hydraulic oil in the bucket cylinder **9** to the hydraulic oil tank.

[0070] The control valve **175**L is a spool valve that switches the flow of the hydraulic oil in order to supply hydraulic oil, which is discharged from the left main pump **14**L, to the boom cylinder **7**. The control valve **175**R is a spool valve that switches the flow of the hydraulic oil in order to: supply hydraulic oil, which is discharged from the right main pump **14**R, to the boom cylinder **7**; and discharge hydraulic oil in the boom cylinder **7** to the hydraulic oil tank.

[0071] The control valve **176**L is a spool valve that switches the flow of the hydraulic oil in order to: supply hydraulic oil, which is discharged from the left main pump **14**L, to the arm cylinder **8**; and discharge hydraulic oil in the arm cylinder **8** to the hydraulic oil tank.

[0072] The control valve **176**R is a spool valve that switches the flow of the hydraulic oil in order to: supply hydraulic oil, which is discharged from the right main pump **14**R, to the arm cylinder **8**; and discharge hydraulic oil in the arm cylinder **8** to the hydraulic oil tank.

[0073] The left parallel line **42**L is a hydraulic oil line parallel to the left center bypass line **40**L. In the case where the flow of hydraulic oil, which flows in the left center bypass line **40**L, is limited or cut off by any of the control valves **171**, **173**, and **175**L, the left parallel line **42**L is capable of supplying hydraulic oil to a control valve located downstream from the any of the control valves **171**, **173**, and **175**L. The right parallel line **42**R is a hydraulic oil line parallel to the right center bypass line **40**R. In the case where the flow of hydraulic oil, which flows in the right center bypass line **40**R, is limited or cut off by any of the control valves **172**, **174**, and **175**R, the right parallel line **42**R is capable of supplying hydraulic oil to a control valve located downstream from the any of the control valves **172**, **174**, and **175**R.

[0074] The regulator **13** includes a left regulator **13**L and a right regulator **13**R. The left regulator **13**L controls the discharge amount of the left main pump **14**L by adjusting a swash plate tilting angle of the left main pump **14**L in response to a discharge pressure of the left main pump **14**L. Specifically, the left regulator **13**L reduces the discharge amount by adjusting the swash plate tilting angle of the left main pump **14**L in response the increase of the discharge pressure of the left main pump **14**L. The same applies to the right regulator **13**R. The above arrangement is for preventing the absorption power (e.g., absorption horsepower) of the main pump **14**, which is expressed as the product of the discharge pressure and the discharge amount, from exceeding the output power (e.g., output horsepower) of the engine **11**.

[0075] The operation device **26** includes a left operation lever **26**L, a right operation lever **26**R, and a traveling lever **26**D. The traveling lever **26**D includes a left traveling lever **26**DL and a right traveling lever **26**DR.

[0076] Left operation lever **26**L is used for a swing operation and an operation of the arm **5**. When the left operation lever **26**L is operated in a front-rear direction, a control pressure in accordance with the operation amount of the lever is introduced to a pilot port of the control valve **176** by using the hydraulic oil discharged from the pilot pump **15**. Further, when the left operation lever **26**L is operated in a left-right direction, a control pressure in accordance with the operation amount of the lever is introduced to a pilot port of the control valve **173** by using the hydraulic oil discharged from the pilot pump **15**.

[0077] Specifically, in the case where the left operation lever **26**L is operated in an arm closing direction, the hydraulic oil is introduced to a right-side pilot port of the control valve **176**L and the hydraulic oil is introduced to a left-side pilot port of the control valve **176**R. Specifically, in the case where the left operation lever **26**L is operated in an arm closing direction, the hydraulic oil is introduced to a left-side pilot port of the control valve **176**L and the hydraulic oil is introduced to a left-side pilot port of the control valve **176**R. Further, in the case where the left operation lever **26**L is operated in a left swing direction, the hydraulic oil is introduced to a left-side pilot port of the control valve **173** and, in the case where the left operation lever **26**L is operated in a right swing direction, the hydraulic oil is introduced to a right-side pilot port of the control valve **173**.

[0078] the right operation lever **26**R is used for an operation of the boom **4** and an operation of the bucket **6**. When the right operation lever **26**R is operated in a front-rear direction, a control pressure in accordance with the operation amount of the lever is introduced to a pilot port of the control valve **175** by using the hydraulic oil discharged from the pilot pump **15**. Further, when the right operation lever **26**R is operated in a left-right direction, a control pressure in accordance with the operation amount of the lever is introduced to a pilot port of the control valve **174** by using the hydraulic oil discharged from the pilot pump **15**.

[0079] Specifically, in the case where the right operation lever **26**R is operated in a boom down direction, the hydraulic oil is introduced to a right-side pilot port of the control valve **175**R. Further, in the case where the right operation lever **26**R is operated in a boom up direction, the hydraulic oil is introduced to a right-side pilot port of the control valve **175**L and the hydraulic oil is introduced to a left-side pilot port of the control valve **175**R. Further, in the case where the right operation lever **26**R is operated in a bucket close direction, the hydraulic oil is introduced to a left-side pilot port of the control valve **174** and, in the case where the right operation lever **26**R is operated in a bucket open direction, the hydraulic oil is introduced to a right-side pilot port of the control valve **174**.

[0080] The traveling lever **26**D is used for an operation of the crawler **10**. Specifically, the left traveling lever **26**DL is used for an operation of the left crawler **1**CL. The left traveling lever **26**DL may be configured to move together with a left traveling pedal. When the left traveling lever **26**DL is operated in a front-rear direction, a control pressure in accordance with the operation amount of the lever is introduced to a pilot port of the control valve **171** by using the hydraulic oil discharged from the pilot pump **15**. The right traveling lever **26**DR is used for an operation of the right crawler **1**CR. The right traveling lever **26**DR may be configured to move together with a right traveling pedal. When the right traveling lever **26**DR is operated in a front-rear direction, a control pressure in accordance with the operation amount of the lever is introduced to a pilot port of the control valve **172** by using the hydraulic oil discharged from the pilot pump **15**.

[0081] The discharge pressure sensor **28** includes a discharge pressure sensor **28**L and a discharge pressure sensor **28**R. The discharge pressure sensor **28**L detects a discharge pressure of the left main pump **14**L, and outputs the detected value to the controller **30**. The same is applied to the discharge pressure sensor **28**R.

[0082] The operation pressure sensor **29** includes an operation pressure sensors **29**LA, **29**LB, **29**RA, **29**RB, **29**DL, and **29**DR, The operation pressure sensor **29**LA detects, in the form of a pressure, operation contents of the left operation lever **26**L in a front-rear direction by an operator, and outputs the detected values to the controller **30**. The operation contents are, for example, a lever operation direction and a lever operation amount (lever operation angle), or the like.

[0083] Similarly, the operation pressure sensor **29**LB detects, in the form of a pressure, operation contents of the left operation lever **26**L in a left-right direction by an operator, and outputs the detected values to the controller **30**. The operation pressure sensor **29**RA detects, in the form of a pressure, operation contents of the right operation lever **26**R in a front-rear direction by an operator, and outputs the detected values to the controller **30**. The operation pressure sensor **29**RB detects, in the form of a pressure, operation contents of the right operation lever **26**R in a left-right direction by an operator, and outputs the detected values to the controller **30**. The operation pressure sensor **29**DL detects, in the form of a pressure, operation contents of the left traveling lever **26**DL in a front-rear direction by an operator, and outputs the detected values to the controller **30**. The operation pressure sensor **29**DR detects, in the form of a pressure, operation contents of the right traveling lever **26**DR in a front-rear direction by an operator, and outputs the detected values to the controller **30**.

[0084] The controller **30** receives outputs of the operation pressure sensor **29**, and outputs a control command to the regulator **13**, if necessary, to change the discharge amount of the main pump **14**. Further, The controller **30** receives outputs of the control pressure sensor **19** that is provided on the upstream side of the aperture **18**, and outputs a control command to the regulator **13**, if necessary, to change the discharge amount of the main pump **14**. The aperture **18** includes a left aperture **18**L and a right aperture **18**R, and the control pressure sensor **19** includes a left control pressure sensor **19**L and the right control pressure sensor **19**R.

[0085] In the left center bypass line **40**, the left aperture **18**L is provided between the control valve **176**L, which is located in the most upstream, and the hydraulic oil tank. As a result, the flow of the hydraulic oil that is discharged from the left main pump **14**L is limited by the left aperture **18**L. Further, the left aperture **18**L generates a control pressure for controlling the left regulator **13**L. The left control pressure sensor **19**L is a sensor for detecting the above-described control pressure, and outputs the detected value to the controller **30**. The controller **30** controls the discharge amount of the left main pump **14**L by adjusting the swash plate tilting angle of the left main pump **14**L in accordance with the-above described control pressure. The controller **30** reduces the, discharge amount of the left main pump **14**L as the control pressure is increased, and increases the discharge amount of the left main pump **14**L as the control pressure is decreased. The discharge amount of the right main pump **14**R is controlled in the same way.

[0086] Specifically, as illustrated in FIG. **3**, in case of a standby state in which any of the hydraulic actuators in the shovel is not operated, the hydraulic oil discharged by the left main pump **14**L goes through the left center bypass line **40**L, and reaches the left aperture **18**L. Further, the flow of the hydraulic oil that is discharged by the left main pump **14**L increases the control pressure that is generated on the upstream side of the left aperture **18**L. As a result, the controller **30** reduces the discharge amount of the left main pump **14**L to the permissible minimum discharge amount, and reduces the pressure loss (pumping loss) when the discharged hydraulic oil passes through the left center bypass line **40**L. On the other hand, in the case where any of the hydraulic actuators is operated, the hydraulic oil, which is discharged by the left main pump **14**L, flows into the hydraulic actuator of the operation target via the control valve corresponding to the hydraulic actuator of the operation target. Further, the flow of the hydraulic oil discharged by the left main pump **14**L causes the amount reaching the left aperture **18**L to be reduced or to be vanished, and causes the control pressure generated on the upstream side of the left aperture **18**L to be reduced. As a result, the controller **30** causes the discharge amount of the left main pump **14**L to be increased, and causes sufficient amount of the hydraulic oil to flow into the hydraulic actuator of the operation target to ensure the drive of the oil actuator of the operation target. It should be noted that the controller **30** controls the discharge amount of the right main pump **14**R in the same way.

[0087] According to the above arrangement, it is possible for the hydraulic system illustrated in FIG. **3** to reduce wasteful energy consumption at the main pump **14** in a standby state. The wasteful energy consumption includes pumping loss generated in the center bypass line **40** by the hydraulic oil discharged by the main pump **14**. Further, it is possible for the hydraulic system illustrated in FIG. **3** to ensure supplying necessary and sufficient hydraulic oil from the main pump **14** to the hydraulic actuator of the operation target.

[0088] Next, referring to FIG. **4**A to FIG. **4**D, FIG. **5**A and FIG. **5**B, an arrangement will be described in which the controller **30** causes the actuators to operate using a machine control function. FIG. **4**A to FIG. **4**D are diagrams illustrating a part of the hydraulic system. Specifically, FIG. **4**A is a diagram illustrating a part of the hydraulic system related to an operation of the arm cylinder **8**, and FIG. **4**B is a diagram illustrating a part of the hydraulic system related to an operation of the hydraulic swing motor **2**A. Further, FIG. **4**C is a drawing illustrating a part of the hydraulic system related to an operation of the boom cylinder **7**, and FIG. **4**D is a drawing illustrating a part of the hydraulic system related to an operation of the bucket cylinder **9**. Similarly, FIG. **5**A and FIG. **5**B are diagrams illustrating a part of the hydraulic system. Specifically, FIG. **4**A is a diagram illustrating a part of the hydraulic system related to an operation of the left hydraulic traveling motor **2**ML, and FIG. **4**B is a diagram illustrating a part of the hydraulic system related to an operation of the right hydraulic traveling motor **2**MR.

[0089] As illustrated in FIG. **4**A to FIG. **4**D, FIG. **5**A and FIG. **5**B, the hydraulic system includes a proportional valve **31** and a shuttle valve **32**. The proportional valve **31** includes proportional valves **31**AL to **31**FL and **31**AR to **31**FR, and the shuttle valve **32** includes shuttle valves **32**AL to **32**FL and **32**AR to **32**FR.

[0090] The proportional valve **31** is configured to function as a machine control valve. The proportional valve **31** is provided in a line that connects the pilot pump **15** and the shuttle valve **32**, and is configured to change the flowing line area of the line. In an embodiment of the present invention, the proportional valve **31** operates in response to a control command output by the controller **30**. Therefore, it is possible for the controller **30** to supply hydraulic oil discharged by the pilot pump **15** to the pilot port of the corresponding control valve in the control valve **17** via the proportional valve **31** and the shuttle valve **32**, regardless of the operation of the operation device **26** by the operator.

[0091] The shuttle valve **32** has two inlet ports and one outlet port. One of the two inlet ports is connected to the operation device **26** and the other is connected to the proportional valve **31**. The outlet port is connected to a pilot port of a corresponding control valve in the control valve **17**. Therefore, the shuttle valve **32** can cause the higher of: the pilot pressure generated by the operation device **26**; and the pilot pressure generated by the proportional valve **31**, to act on the pilot port of the corresponding control valve.

[0092] According to the above arrangement, it is possible for the controller **30** to cause the hydraulic actuator corresponding to the specific operation device **26**, even in the case where no operation is performed on the specific operation device **26**.

[0093] For example, as illustrated in FIG. **4**A, the left operation lever **26**L is used for operating the arm **5**. Specifically, the left operation lever **26**L uses hydraulic oil discharged by the pilot pump **15** to apply a pilot pressure, which corresponds to the operation in the front-rear direction, to the pilot port of the control valve **176**. More specifically, in the case where the left operation lever **26**L is operated in an arm-close direction (rearward direction), the left operation lever **26**L applies a pilot pressure, which corresponds to the operation amount, to a right-side pilot port of the control valve **176**L and to a left-side pilot port of the control valve **176**R. Further, in the case where the left operation lever **26**L is operated in an arm-open direction, the left operation lever **26**L applies a pilot pressure, which corresponds to the operation amount, to a left-side pilot port of the control valve **176**L and to a right-side pilot port of the control valve **176**R.

[0094] The left operation lever **26**L is provided with a switch NS. In an embodiment of the present invention, the switch NS is a push-button switch. It is possible for an operator to operate the left operation lever **26**L with a hand while pushing the switch NS with a finger. The switch NS may be provided in the right operation lever **26**R, or may be provided at another location in the cabin **10**.

[0095] The operation pressure sensor **29**LA detects, in the form of a pressure, operation contents of the left operation lever **26**L in a front-rear direction by an operator, and outputs the detected values to the controller **30**.

[0096] The proportional valve **31**AL operates in response to a current command output by the controller **30**. Further, the proportional valve **31**AL adjusts a pilot pressure that is generated by hydraulic oil that is introduced from the pilot pump **15** to the right-side pilot port of the control valve **176**L and to the left-side pilot port of the control valve **176**R via the proportional valve **31**AL and the shuttle valve **32**AL. The proportional valve **31**AR operates in response to a current command output by the controller **30**. Further, the proportional valve **31**AR adjusts a pilot pressure that is generated by hydraulic oil that is introduced from the pilot pump **15** to the left-side pilot port of the control valve **176**L and to the right-side pilot port of the control valve **176**R via the proportional valve **31**AR and the shuttle valve **32**AR. Each of the proportional valves **31**AL and **31**AR is capable of adjusting the pilot pressure so that the control valve **176** is stopped at any valve position.

[0097] According to the above arrangement, it is possible for the controller **30** to supply hydraulic oil discharged by the pilot pump **15** to the right-side pilot port of the control valve **176**L and to the left-side pilot port of the control valve **176**R via the proportional valve **31**AL and the shuttle valve **32**AL, regardless of the arm-close operation by an operator. In other words, it is possible for the controller **30** to close the arm **5**, regardless of the arm-close operation by an operator. Further, it is possible for the controller **30** to supply hydraulic oil discharged by the pilot pump **15** to the left-side pilot port of the control valve **176**L and to the right-side pilot port of the control valve **176**R via the proportional valve **31**AR and the shuttle valve **32**AR, regardless of the arm-open operation by an operator. In other words, it is possible for the controller **30** to open the arm **5**, regardless of the arm-open operation by an operator.

[0098] Further, as illustrated in FIG. **4**B, the left operation lever **26**L is also used for operating the swing mechanism **2**. Specifically, the left operation lever **26**L uses hydraulic oil discharged by the pilot pump **15** to apply a pilot pressure, which corresponds to the operation in the left-right direction, to the pilot port of the control valve **173**. More specifically, in the case where the left operation lever **26**L is operated in a left swing direction (left direction), the left operation lever **26**L applies a pilot pressure, which corresponds to the operation amount, to a left-side pilot port of the control valve **173**. Further, in the case where the left operation lever **26**L is operated in a right swing direction (right direction), the left operation lever **26**L applies a pilot pressure, which corresponds to the operation amount, to a right-side pilot port of the control valve **173**.

[0099] The operation pressure sensor **29**LB detects, in the form of a pressure, operation contents of the left operation lever **26**L in a left-right direction by an operator, and outputs the detected values to the controller **30**.

[0100] The proportional valve **31**BL operates in response to a current command output by the controller **30**. Further, the proportional valve **31**BL adjusts a pilot pressure that is generated by hydraulic oil that is introduced from the pilot pump **15** to the left-side pilot port of the control valve **173** via the proportional valve **31**BL and the shuttle valve **32**BL. The proportional valve **31**BR operates in response to a current command output by the controller **30**. Further, the proportional valve **31**BR adjusts a pilot pressure that is generated by hydraulic oil that is introduced from the pilot pump **15** to the right-side pilot port of the control valve **173** via the proportional valve **31**BR and the shuttle valve **32**BR. Each of the proportional valves **31**BL and **31**BR is capable of adjusting the pilot pressure so that the control valve **173** is stopped at any valve position.

[0101] According to the above arrangement, it is possible for the controller **30** to supply hydraulic oil discharged by the pilot pump **15** to the left-side pilot port of the control valve **173** via the proportional valve **31**BL and the shuttle valve **32**BL, regardless of the left swing operation by an operator. In other words, it is possible for the controller **30** to cause the swing mechanism **2** to swing left, regardless of the swing-left operation by an operator. Further, it is possible for the controller **30** to supply hydraulic oil discharged by the pilot pump **15**-to the right-side pilot port of the control valve **173** via the proportional valve **31**BR and the shuttle valve **32**BR, regardless of the swing-right operation by an operator. In other words, it is possible for the controller **30** to cause the swing mechanism **2** to swing right, regardless of the swing-right operation by an operator.

[0102] Further, as illustrated in FIG. **4**C, the right operation lever **26**R is used for operating the boom **4**. Specifically, the right operation lever **26**R uses hydraulic oil discharged by the pilot pump **15** to apply a pilot pressure, which corresponds to the operation in the front-rear direction, to the pilot port of the control valve **175**. More specifically, in the case where the right operation lever **26**R is operated in a boom up direction (rearward direction), the right operation lever **26**R applies a pilot pressure, which corresponds to the operation amount, to a right-side pilot port of the control valve **175**L and to a left-side pilot port of the control valve **175**R. Further, in the case where the right operation lever **26**R is operated in a boom down direction (forward direction), the right operation lever **26**R applies a pilot pressure, which corresponds to the operation amount, to a right-side pilot port of the control valve **175**R.

[0103] The operation pressure sensor **29**RA detects, in the form of a pressure, operation contents of the right operation lever **26**R in a front-rear direction by an operator, and outputs the detected values to the controller **30**.

[0104] The proportional valve **31**CL operates in response to a current command output by the controller **30**. Further, the proportional valve **31**CL adjusts a pilot pressure that is generated by hydraulic oil that is introduced from the pilot pump **15** to the right-side pilot port of the control valve **175**L and to the left-side pilot port of the control valve **175**R via the proportional valve **31**CL and the shuttle valve **32**CL. The proportional valve **31**CR operates in response to a current command output by the controller **30**. Further, the proportional valve **31**CR adjusts a pilot pressure that is generated by hydraulic oil that is introduced from the pilot pump **15** to the left-side pilot port of the control valve **175**L and to the right-side pilot port of the control valve **175**R via the proportional valve **31**CR and the shuttle valve **32**CR. Each of the proportional valves **31**CL and **31**CR is capable of adjusting the pilot pressure so that the control valve **175** is stopped at any valve. position.

[0105] According to the above arrangement, it is possible for the controller **30** to supply hydraulic oil discharged by the pilot pump **15** to the right-side pilot port of the control valve **175**L and to the left-side pilot port of the control valve **175**R via the proportional valve **31**CL and the shuttle valve **32**CL, regardless of the boom up operation by an operator. In other words, it is possible for the controller **30** to move up the boom **4**, regardless of the boom up operation by an operator. Further, it is possible for the controller **30** to supply hydraulic oil discharged by the pilot pump **15**-to the right-side pilot port of the control valve **175**R via the proportional valve **31**CR and the shuttle valve **32**CR, regardless of a boom down operation by an operator. In other words, it is possible for the controller **30** to move down the boom **4**, regardless of the boom down operation by an operator.

[0106] Further, as illustrated in FIG. **4**D, the right operation lever **26**R is also used for operating the bucket **6**. Specifically, the right operation lever **26**R uses hydraulic oil discharged by the pilot pump **15** to apply a pilot pressure, which corresponds to the operation in the left-right direction, to the pilot port of the control valve **174**. More specifically, in the case where the right operation lever **26**R is operated in a bucket close direction (left direction), the right operation lever **26**R applies a pilot pressure, which corresponds to the operation amount, to a left-side pilot port of the control valve **174**. Further, in the case where the right operation lever **26**R is operated in a bucket open direction (right direction), the right operation lever **26**R applies a pilot pressure, which corresponds to the operation amount, to a right-side pilot port of the control valve **174**.

[0107] The operation pressure sensor **29**RB detects, in the form of a pressure, operation contents of the right operation lever **26**R in a left-right direction by an operator, and outputs the detected values to the controller **30**.

[0108] The proportional valve **31**DL operates in response to a current command output by the controller **30**. Further, the proportional valve **31**DL adjusts a pilot pressure that is generated by hydraulic oil that is introduced from the pilot pump **15** to the left-side pilot port of the control valve **174** via the proportional valve **31**DL and the shuttle valve **32**DL. The proportional valve **31**DR operates in response to a current command output by the controller **30**. Further, the proportional valve **31**DR adjusts a pilot pressure that is generated by hydraulic oil that is introduced from the pilot pump **15** to the right-side pilot port of the control valve **174** via the proportional valve **31**DR and the shuttle valve **32**DR. Each of the proportional valves **31**DL and **31**DR is capable of adjusting the pilot pressure so that the control valve **174** is stopped at any valve position.

[0109] According to the above arrangement, it is possible for the controller **30** to supply hydraulic oil discharged by the pilot pump **15**-to the left-side pilot port of the control valve **174** via the proportional valve **31**DL and the shuttle valve **32**DL, regardless of the bucket close operation by an operator. In other words, it is possible for the controller **30** to close the bucket **6**, regardless of the bucket close operation by an operator. Further, it is possible for the controller **30** to supply hydraulic oil discharged by the pilot pump **15** to the right-side pilot port of the control valve **174** via the proportional valve **31**ER and the shuttle valve **32**DR, regardless of a bucket open operation by an operator. In other words, it is possible for the controller **30** to open the bucket **6**, regardless of the bucket-open operation by an operator.

[0110] Further, as illustrated in FIG. **5**A, the left traveling lever **26**DL is used for operating the left crawler **1**CL. Specifically, the left traveling lever **26**DL uses hydraulic oil discharged by the pilot pump **15** to apply a pilot pressure, which corresponds to the operation in the front-rear direction, to the pilot port of the control valve **171**. More specifically, in the case where the left traveling lever **26**DL is operated in a move forward direction (forward direction), the left traveling lever **26**DL applies a pilot pressure, which corresponds to the operation amount, to a left-side pilot port of the control valve **171**. Further, in the case where the left traveling lever **26**DL is operated in a move backward direction (backward direction), the left traveling lever **26**DL applies a pilot pressure, which corresponds to the operation amount, to a right-side pilot port of the control valve **171**.

[0111] The operation pressure sensor **29**DL detects, in the form of a pressure, operation contents of the left traveling lever **26**DL in a front-rear direction by an operator, and outputs the detected values to the controller **30**.

[0112] The proportional valve **31**EL operates in response to a current command output by the controller **30**. Further, the proportional valve **31**EL adjusts a pilot pressure that is generated by hydraulic oil that is introduced from the pilot pump **15** to the left-side pilot port of the control valve **171** via the proportional valve **31**EL and the shuttle valve **32**EL. The proportional valve **31**ER operates in response to a current command output by the controller **30**. Further, the proportional valve **31**ER adjusts a pilot pressure that is generated by hydraulic oil that is introduced from the pilot pump **15** to the right-side pilot port of the control valve **171** via the proportional valve **31**ER and the shuttle valve **32**ER. Each of the proportional valves **31**EL and **31**ER is capable of adjusting the pilot pressure so that the control valve **171** is stopped at any valve position.

[0113] According to the above arrangement, it is possible for the controller **30** to supply hydraulic oil discharged by the pilot pump **15**-to the left-side pilot port of the control valve **171** via the proportional valve **31**EL and the shuttle valve **32**EL, regardless of a left move-forward operation by an operator. In other words, it is possible for the controller **30** to move forward the left crawler **1**CL, regardless of the left move-forward operation by an operator. Further, it is possible for the controller **30** to supply hydraulic oil discharged by the pilot pump **15** to the right-side pilot port of the control valve **171** via the proportional valve **31**ER and the shuttle valve **32**ER, regardless of a left move-backward operation by an operator. In other words, it is possible for the controller **30** to move backward the left crawler **1**CL, regardless of the left move-backward operation by an operator.

[0114] Further, as illustrated in FIG. **5**B, the right traveling lever **26**DR is used for operating the right crawler **1**CR. Specifically, the right traveling lever **26**DR uses hydraulic oil discharged by the pilot pump **15** to apply a pilot pressure, which corresponds to the operation in the front-rear direction, to the pilot port of the control valve **172**. More specifically, in the case where the right traveling lever **26**DR is operated in a move forward direction (forward direction), the right traveling lever **26**DR applies a pilot pressure, which corresponds to the operation amount, to a right-side pilot port of the control valve **172**. Further, in the case where the right traveling lever **26**DR is operated in a move backward direction (backward direction), the right traveling lever **26**DR applies a pilot pressure, which corresponds to the operation amount, to a left-side pilot port of the control valve **172**.

[0115] The operation pressure sensor **29**DR detects, in the form of a pressure, operation contents of the right traveling lever **26**DR in a front-rear direction by an operator, and outputs the detected values to the controller **30**.

[0116] The proportional valve **31**FL operates in response to a current command output by the controller **30**. Further, the proportional valve **31**FL adjusts a pilot pressure that is generated by hydraulic oil that is introduced from the pilot pump **15** to the left-side pilot port of the control valve **172** via the proportional valve **31**FL and the shuttle valve **32**FL.

The proportional valve **31**FR operates in response to a current command output by the controller **30**. Further, the proportional valve **31**FR adjusts a pilot pressure that is generated by hydraulic oil that is introduced from the pilot pump **15** to the right-side pilot port of the control valve **172** via the proportional valve **31**FR and the shuttle valve **32**FR. Each of the proportional valves **31**FL and **31**FR is capable of adjusting the pilot pressure so that the control valve **172** is stopped at any valve position.

[0117] According to the above arrangement, it is possible for the controller **30** to supply hydraulic oil discharged by the pilot pump **15**-to the right-side pilot port of the control valve **172** via the proportional valve **31**FL and the shuttle valve **32**FL, regardless of a right move-forward operation by an operator. In other words, it is possible for the controller **30** to move forward the right crawler **1**CR, regardless of the right move-forward operation by an operator. Further, it is possible for the controller **30** to supply hydraulic oil discharged by the pilot pump **15** to the left-side pilot port of the control valve **172** via the proportional valve **31**FR and the shuttle valve **32**FR, regardless of a right move-backward operation by an operator. In other words, it is possible for the controller **30** to move backward the right crawler **1**CR, regardless of the right move-backward operation by an operator.

[0118] It should be noted that, although a hydraulic operation lever with a hydraulic pilot circuit is employed in the above-described embodiment, an electric operation lever with an electric pilot circuit may be employed instead of the hydraulic operation lever with a hydraulic pilot circuit. In this case, the lever operation amount of the electric operation lever is input the controller **30** as an electric signal. Further, an electromagnetic valve (solenoid valve) is provided between the pilot pump **15** and a pilot port of each control valve. The electromagnetic valve is configured to operate in response to an electric signal from the controller **30**. According to the above arrangement, when an manual operation is performed by using the electric operation lever, it is possible for the controller **30** to move each control valve by controlling the electromagnetic valve by an electric signal corresponding to the lever operation amount to increase or reduce the pilot pressure to move each control valve. It should be noted that each control valve may be formed by an electromagnetic spool valve (solenoid spool valve). In this case, the electromagnetic valve operates in response to an electric signal, corresponding to the lever operation amount of the electric operation lever, from the controller **30**.

[0119] Next, referring to FIG. **6**, functions of the controller **30** will be described. FIG. **6** is a functional block diagram illustrating a configuration example of the controller **30**. In an example of FIG. **3**, the controller **30** is configured to: receive a signal output by at least one of the posture detection device, the operation device **26**, the space recognition device **70**, the orientation detection device **71**, the information input device **72**, the positioning device **73**, the switch NS, etc.; to perform various calculations; and to output a control command to at least one of the proportional valve **31**, the display device D**1**, the sound output device D**2**, etc. The posture detection device includes the boom angle sensor S**1**, the arm angle sensor S**2**, the bucket angle sensor S**3**, the device body inclination sensor S**4**, and the swing angular velocity sensor S**5**. The controller **30** includes, as functional elements responsible for various functions, a posture detection unit **30**A, a determination unit **30**B, and an autonomous control unit **30**C. Each functional element may be made by hardware, or may be made by software.

[0120] The posture detection unit **30**A is configured to detect information related to a posture of the shovel **100**. In an embodiment of the present invention, the posture detection unit **30**A detects information related to the posture of the shovel **100** based on an output of the posture detection device. The posture detection unit **30**A may detect, as the posture of the shovel **100**, the posture of the excavating attachment AT based on an output of the posture detection device. Further, the posture detection unit **30**A may detect, as the posture of the shovel **100**, the posture of the upper-part swing body **3** (an orientation of the upper-part swing body **3** relative to an orientation of the lower-part traveling body **1**) based on at least one of the posture detection device and the orientation detection device.

[0121] The determination unit **30**B is configured to determine whether a desired space exists or not. In an embodiment of the present invention, the determination unit **30**B is configured to determine: whether a parking space, in which the shovel **100** can park, exists or not;

[0122] and whether a passing space, through which the shovel **100** can pass, exists or not. In other words, the determination unit **30**B is configured to determine: whether there exists a space that is larger than the body of the shovel **100** in a space specified as a parking space; or, whether there exist continual spaces that are larger than the body of the shovel **100** (that allow the body of the shovel **100** to pass) on the route from the current location to the space specified as the parking space. Specifically, the determination unit **30**B determines whether there exists a parking space based on an output of the space recognition device **70**. Further, in the case where the determination unit **30**B determines that there exists a parking space, the determination unit **30**B determines whether there exists a passing space used for moving the shovel **100** from the current location to the parking space without causing the shovel **100** to touch an external object. Further, in the case where the determination unit **30**B determines that there exists a passing space, the determination unit **30**B determines that the shovel can be moved to the parking space and that the shovel **100** can be parked.

[0123] The autonomous control unit **30**C is configured to autonomously operate the shovel **100**. In an embodiment of the present invention, the autonomous control unit **30**C is configured to calculate a target trajectory from the current location of the shovel **100** to the parking space, and to cause the shovel **100** to move along the target trajectory. The target trajectory is a trajectory that is drawn by a predetermined part of the shovel **100** when the shovel **100** autonomously moves. The target trajectory includes, for example, a target trajectory related to the crawler **1**C. In this case, the predetermined part is, for example, a front end or a rear end of the crawler **1**C. The target trajectory may include, for example, a target trajectory related to the excavating attachment AT. In this case, the predetermined part is, for example, a top end of the boom **4**. The target trajectory may be a trajectory drawn by a center point of the shovel **100** as the predetermined part. The center point of the shovel **100** is typically a point on the swing axis. Alternatively, the target trajectory may be a trajectory, with a width, drawn by the outline of the shovel **100** moving from the current location to the parking space.

[0124] The target trajectory is calculated, for example, so that the shovel **100** is moved to a specific parking space and is caused to park. In this case, the target trajectory is calculated by taking into account the movement that can be realized by the shovel **100**. Further, the autonomous control unit **30**C determines how to operate actuators based on the calculated target trajectory. For example, when causing the shovel **100** to move backward, the autonomous control unit **30**C selects an appropriate moving method from a spin turn, a pivot turn, a slow turn, and a moving straight, and determines how to operate the hydraulic traveling motor **2**M. In this case, the autonomous control unit **30**C may determine, not only the necessity of operating the traveling driving unit such as the hydraulic traveling motor **2**M, but also the necessity of operating the swing mechanism **2**. Further, the autonomous control unit **30**C may determine whether there is a risk that the attachment may touch peripheral equipment or other construction machines, and may determine the necessity of operating the attachment.

[0125] Next, referring to FIG. **7**, a process (hereinafter, referred to as "parking process") of moving, by the controller **30**, the shovel **100** and causing the shovel **100** to park, will be described. FIG. **7** is a flowchart illustrating an example of the parking process.

[0126] First, the controller **30** determines whether a parking mode button is pushed (step ST**1**). In an embodiment of the present invention, the controller **30** performs this determination repeatedly for each predetermined control cycle. The parking mode button is, for example, a switch NS that is provided on the top end of the left operation lever **26**L. The parking mode button may be a software button that is displayed by the display device D**1** with a touch panel. The controller **30** repeats this determination until the controller **30** determines that the parking mode button is pushed (NO in step ST**1**).

[0127] In the case when it is determined that the parking mode button is pushed (YES in step ST**1**), the controller **30** displays a setting screen (step ST**2**). In an embodiment of the present invention, the controller **30** displays, as the setting screen, a parking space selection screen on the display device D**1**.

[0128] FIG. **8** is a drawing illustrating a configuration example of the parking space selection screen. A parking space selection screen GA includes a shovel graphic G**1** and a parking space graphic G**2**. The parking space selection screen illustrated in FIG. **8** may be displayed by a display device installed in a support device including a mobile terminal such as a smart phone, possessed by the operator. In this case, the support device may function as a communication device, and may control communications with the shovel via a near field communication network such as Wi-Fi (registered trademark), Bluetooth (registered trademark), wireless LAN, or the like, a mobile phone communication network, a satellite communication network, etc.

[0129] The shovel graphic G**1** and the parking space graphic G**2** indicate a locational relation between the upper-part swing body **3** and the parking space. In an embodiment of the present invention, the shovel graphic G**1** represents a shape of the upper-part swing body **3** viewed from directly above the upper-part swing body **3**. The parking space graphic G**2** represents an approximate location, with respect to the upper-part swing body **3**, of a space that can be set as a parking space. Specifically, the parking space graphic G**2** includes: a right parking space graphic G**2**R representing a space located on the right side of the upper-part swing body **3**; a front parking space graphic G**2**F representing a space located on the front side of the upper-part swing body **3**; a left parking space graphic G**2**L representing a space located on the left side of the upper-part swing body **3**; and a rear parking space graphic G**2**B representing a space located on the rear side of the upper-part swing body **3**. It should be noted, however, that the parking space graphic G**2** may include five or more parking space figures including at least one of a right-sided front parking space figure, a left-sided front parking space figure, a right-sided rear parking space figure, a left-sided rear parking space figure, etc. Further, the parking space graphic G**2** may represent a more precise location, with respect to the upper-part swing body **3**, of a space that can be set as a parking space. Alternatively, the parking space graphic G**2** may only correspond to a parking space that is recognized by the space recognition device **70**. In this case, if, for example, the controller **30** determines that there exists no parking space on the left side of the upper-part swing body **3**, then the controller **30** may not display the left parking space graphic G**2**L.

[0130] The parking space graphic G**2** may be superimposed on a camera image. The camera image is, for example, a bird's eye image as a view conversion image that is generated based on images captured by a plurality of cameras attached to the upper-part swing body **3**. In this case, the bird's eye image is displayed around the shovel graphic G**1**.

[0131] Further, the parking space selection screen GA may be: a screen related to a view when viewing backward from the shovel **100**; or a screen related to a view when viewing the side from the shovel **100**, instead of a screen related to a view that is viewed from directly above the shovel **100** as described above.

[0132] An operator of the shovel **100** selects a parking space graphic G**2** that includes a space in which the shovel is to be parked while looking at the parking space selection screen GA.

[0133] Thereafter, the controller **30** determines whether a target parking space is determined (step ST**3**). An operator of the shovel **100** presses the parking mode button in the cabin **10** of the shovel **100** located at a location illustrated in FIG. **9**, for example. FIG. **9** is a top view of an actual parking lot at a construction site or at a garage (parking apron). When the parking mode button is pushed, the controller **30** displays the parking space selection screen GA. At this time, it is possible for an operator to set, as a target parking space, a space SP in the actual parking lot by selecting the right parking space graphic G**2**R.

[0134] In an example of FIG. **9**, when the left parking space graphic G**2**L is selected, the determination unit **30**B of the controller **30** determines whether there exists a space, in which the shovel **100** can be parked, on the left side of the upper-part swing body **3**, based on an output of the space recognition device **70**. In an example of FIG. **9**, there is a wall on the left side of the upper-part swing body **3**, and there exists no space in which the shovel **100** can be parked. In this case, the determination unit **30**B may determine that there exists no space in which the shovel **100** can be parked on the left side of the upper-part swing body **3**, and may display a text message indicating the same on the parking space selection screen GA.

[0135] Similarly, when the right parking space graphic G**2**R is selected, the determination unit **30**B determines whether there exists a space, in which the shovel **100** can be parked, on the right side of the upper-part swing body **3**, based on an output of the space recognition device **70**.

[0136] In an example of FIG. **9**, the space SP specified as the parking space is a space larger than the body of the shovel **100**. In other words, there exists a space SP in which the shovel **100** can be parked on the right side of the upper-part swing body **3**. The controller **30** recognizes the specified space SP as the end point of the target trajectory. Therefore, it is possible for the controller **30** to stop the traveling of the shovel **100** at the specified space SP even if there exists another space farther than the specified space SP.

[0137] In this case, the determination unit **30**B determines that there exists a space SP in which the shovel **100** can be parked on the right side of the upper-part swing body **3**. In the case where the determination unit **30**B determines that there exists the space SP, the determination unit **30**B determines whether there exists a passing space used for moving the shovel **100** from the current location to the space SP. In other words, the determination unit **30**B determines whether there exist continual spaces that are larger than the body of the shovel **100** (that allow the body of the shovel **100** to pass) on the route from the current location to the specified space SP.

[0138] In the case where the determination unit **30**B determines that the passing space cannot be secured because of a reason that there exists an obstacle between the current location and the space SP, etc., the determination unit **30**B may determine that the shovel **100** cannot be moved to the space SP, and may display a text message indicating the same on the parking space selection screen GA. In the case where the determination unit **30**B determines that the passing space can be secured, the determination unit **30**B sets the space SP as the target parking space.

[0139] In the case where it is determined that the target parking space has not been set (NO in step ST**3**), the controller **30** repeats the determination of step ST**3** until the target parking space is set.

[0140] In the case when it is determined that the target parking space is set (YES in step ST**3**), the controller **30** adjusts the posture of an attachment (step ST**4**). In an embodiment of the present invention, the autonomous control unit **30**C of the controller **30** changes the posture of the excavating attachment AT to a posture suitable for traveling (hereinafter, referred to as "traveling posture"). The traveling posture is a pre-registered posture, and is, for example, a posture in which the boom angle θ**1** is the maximum, the arm angle θ**2** and the bucket angle θ**3** are the minimum. Specifically, in the case where the posture detection unit **30**A determines that the detected posture of the excavating attachment AT is not the traveling posture, the autonomous control unit **30**C changes the posture of the excavating attachment AT to the traveling posture.

[0141] In an embodiment of the present invention, the controller **30** is configured based on the assumption that, basically, an operator of the shovel **100** does not operate the operation device **26** while processes of step ST**4** and later are being performed. Therefore, the shovel **100** may be configured in such a way that an operation of the operation device **26** by an operator is disabled excluding an operation for forcibly terminating the parking process. The operation for forcibly terminating the parking process is, for example, a re-operation of the parking mode button. Further, an operator of the shovel **100** may perform operations related to processes up to step ST**3** from outside of the cabin **10**. In this case, while the processes of step ST**4** and later are being performed, it is possible for an operator of the shovel **100** to monitor the operation of the shovel **100** from outside the cabin **10**, and to forcibly terminate the parking process if necessary by an operation from a mobile terminal, etc.

[0142] Thereafter, the autonomous control **30**C determines the target trajectory (step ST**5**). In an example of FIG. **9**, the autonomous control unit **30**C determines the trajectory drawn by the rear end of the crawler **10** as the shovel **100** moves from the current location to the space SP. Further, the autonomous control unit **30**C determines the space SP as the end point of the target trajectory. At this time, the order of operations of the crawler **10** based on the necessity of turns is also determined. The order of operations of the crawler **10** may include, for example, the order of operations of the left hydraulic traveling motor **2**ML and the order of operations of the right hydraulic traveling motor **2**MR.

[0143] Thereafter, the autonomous control unit **30**C causes the shovel **100** to move along the determined target trajectory (step ST**6**). In an example of FIG. **9**, the autonomous control unit **30**C first performs a spin turn of about **45** degrees in a counterclockwise direction and causes the rear end of the crawler **10** to face the space SP based on the determined movement of the crawler **10**. Specifically, the autonomous control unit **30**C performs the spin turn in a counterclockwise direction by causing the right hydraulic traveling motor **2**MR to rotate in a forward direction and by causing the left hydraulic traveling motor **2**ML to rotate in a reverse direction. Subsequently, the autonomous control unit **30**C performs a slow turn, while causing the shovel **100** to move backward along the target trajectory that is slowly curved counterclockwise, causes the orientation of the lower-part traveling body **1** to be the same orientation as other shovels that are parked around the shovel **100**. Specifically, the autonomous control unit **30**C performs the slow turn in a counterclockwise direction by causing the left hydraulic traveling motor **2**ML to rotate in the reverse direction at a rotation speed faster than the reverse rotation speed of the right hydraulic traveling motor **2**MR. Thereafter, the autonomous control unit **30**C causes the shovel **100** to move straight backward and causes the entire shovel **100** to enter the space SP. Specifically, the autonomous control unit **30**C causes the shovel **100** to move straight backward by causing the right hydraulic traveling motor **2**MR and the left hydraulic traveling motor **2**ML to rotate in the reverse direction at the same rotation speed.

[0144] When moving the crawler **10**, the autonomous control unit **30**C may change the posture of the excavating attachment AT as necessary. For example, in the case where it is determined there is a risk that the excavating attachment AT may touch an electrical wire (power line) that is extended at a higher location than the cabin **10** if the shovel **100** moves backward, the boom **4** may be lowered. In this case, the autonomous control unit **30**C may recognize an obstacle such as an electrical wire based on an output of the space recognition device **70**. Further, after passing through under the electrical wire, the autonomous control unit **30**C may raise the boom **4** and return the posture of the excavating attachment AT to the traveling posture.

[0145] Further, When moving the crawler **1**C, the autonomous control unit **30**C may cause the upper-part swing body **3** to swing as necessary. For example, in an example of FIG. **9**, if the autonomous control unit **30**C performs a spin turn of 45 degrees or more in a counterclockwise direction without causing the upper-part swing body **3** to swing, there is a risk that the excavating attachment AT may touch the wall W. In this case, the autonomous control unit **30**C may prevent the excavating attachment AT from touching the wall W by causing the upper-part swing body **3** to swing in a clockwise direction before or during the spin turn. It should be noted that the autonomous control unit **30**C may recognize the existence of an obstacle such as the wall W based on an output of the space recognition device **70**, for example.

[0146] Thereafter, the autonomous control unit **30**C caused the attachment to touch the ground in the target parking space (step ST**7**). In an example of FIG. **9**, the autonomous control unit **30**C causes the movement of the crawler **10** to stop after causing the entire shovel **100** to enter the space SP, and changes the posture of the excavating attachment AT to a posture suitable for parking (hereinafter, referred to as "parking posture"). The parked posture is a pre-registered posture, and is, for example, a posture in which the bucket **6** is in contact with the ground surface. It should be noted, however, that the parking posture may be the same as the traveling posture, or may be another posture in which the excavating attachment AT is not in contact with the ground surface. Further, the parking posture may be configured to be selected from a plurality of postures. The same applies to the traveling posture.

[0147] Thereafter, the autonomous control unit **30**C notifies the parking completion (step ST**8**). In an embodiment of the present invention, at the time when the posture of the excavating attachment AT is changed to the parking posture, the autonomous control unit **30**C causes the display device D**1** to display information indicating the parking completion and causes the sound output device D**2** to output information indication the parking completion.

[0148] Next, referring to FIG. **10**, another example of a parking space selection screen will be described. FIG. **10** is a drawing illustrating another configuration example of the parking space selection screen. The parking space selection screen GB includes map figures including information related to arrangement of other construction machines in the parking lot, a depot, an office, etc., and a parking space graphic GS. The depot is, for example, a place used for loading the shovel **100** onto a transporting vehicle such as a trailer or for unloading the shovel **100** from the transporting vehicle.

[0149] The parking space graphic GS indicates a location of a parking space that can be selected as a parking space used for parking the shovel **100**. In an example of FIG. **10**, the parking space graphic GS includes **27** parking space graphics GS**1** to GS**27**. Specifically, the parking space graphic GS illustrated in FIG. **10** corresponds to the parking lot illustrated in FIG. **11**. FIG. **11** is a top view of an actual parking lot. The parking lot illustrated in FIG. **11** is a parking lot owned by a construction machine rental company, for example, and includes three parking space rows, each of the parking space rows allowing nine shovels to park. In the parking lot illustrated in FIG. **11**, at present, eighteen shovels are parked other than the shovel **100** that has just unloaded from a trailer. In an example of FIG. **11**, location information related to each parking space is pre-registered. The location information related to each parking space includes, for example, a latitude, a longitude and an altitude of a center point of each parking space.

[0150] As illustrated in FIG. **10**, the controller **30** may display the parking space graphic GS in such a way that an operator can distinguish between: the parking space graphic GS related to parking spaces that are already parked by other construction machines, such as shovels, bulldozers, wheel loaders, cranes, road rollers, etc.; and the parking space graphic GS related to parking spaces that are not parked by other construction machines. In an example of FIG. **10**, dot-hatching is applied to the parking space graphic GS related to parking spaces that are already parked by other construction machined. On the other hand, dot-hatching is not applied to the parking space graphic GS related to parking spaces that are not parked by other construction machines.

[0151] In this case, in each construction machine such as a shovel, a wheel loader, etc., a device such as a GNSS receiver that is capable of identifying location information is installed. Further, the location information of each construction machine is transmitted from each construction machine to a management device that is provided in an office, etc., via a communication network such as a near field radio communication network, a mobile phone communication network, a satellite communication network, etc. According to the above, it is possible for the management device to obtain current location information of each construction machine and obtain arrangement information in the parking lot. Further, it is possible for the management device to transmit the arrangement information to the shovel **100** that is going to be parked in the parking lot. According to the above, it is possible for an operator of the shovel **100** to check the parking space selection screen GB illustrated in FIG. **10** on the display device D**1** provided inside of the cabin **10**. Further, the parking space selection screen illustrated in FIG. **10** may be displayed by a display device D**1** of the management device. Further, the parking space selection screen illustrated in FIG. **10** may be displayed by a display device D**1** of a support device including a mobile terminal such as a smart phone, possessed by the operator.

[0152] In a situation described above, the operator of the shovel **100** selects, while looking at the parking space selection screen GB inside or outside of the cabin **10**, a parking space graphic GS corresponding to a parking space for the shovel **100** to be parked, by a touch operation, etc. As illustrated in FIG. **10**, the controller **30** may display the parking space selection screen GB in such a way that the operator can distinguish between the parking space graphic GS selected by the operator and other parking space graphics GS. In an example of FIG. **10**, diagonal-hatching is applied to the parking space graphic GS**26** that is selected by the operator.

[0153] In this way, it is possible for an operator of the shovel **100** to set, as a target parking space, a space SP in an actual parking lot illustrated in FIG. **11** by selecting the parking space graphic GS**26**.

[0154] In the case where it is determined that the target parking space is set, the autonomous control unit **30**C of the controller **30** generates a trajectory from the current location to the specified space based on the arrangement information, and operates at least one of the left hydraulic traveling motor **2**ML and the right hydraulic traveling motor **2**MR. Further, the autonomous control unit **30**C, while comparing an output of the positioning device **73** with the generated trajectory, operates at least one of the left hydraulic traveling motor **2**ML and the right hydraulic traveling motor **2**MR, and moves the shovel **100** to close to the target parking space. In an example of FIG. **11**, the autonomous control unit **30**C moves the shovel **100** along a traveling route TR illustrated by a dashed line. The generation of the trajectory from the current location to the specified space based on the arrangement information may be performed by the management device. When moving the shovel **100**, as described above, the autonomous control unit **30**C may change the posture of the excavating attachment AT as necessary so that the shovel **100** does not touch other objects, or may cause the upper-part swing body **3** to swing.

[0155] Next, referring to FIG. **12**, yet another example of a parking space selection screen will be described. FIG. **12** illustrates a parking space selection screen GC that is a yet another configuration example of the parking space selection screen. The parking space selection screen GC includes graphics G**10** to G**15**. The graphic G**10** represents the shovel **100** that is going to be parked by an operator. The graphic G**11** represents a shovel that is already parked. In an example illustrated in FIG. **12**, the display device D**1** displays eighteen graphics G**11** representing respective eighteen shovels that are already parked. In FIG. **12**, one of the eighteen graphics G**11** is specified using a drawing line.

[0156] A graphic G**12** represents a parking space that can be used for the shovel **100** to be parked. In an example illustrated in FIG. **12**, the display device D**1** displays four graphics G**12** (graphics G**12**A to G**12**D) representing respective selectable parking spaces. Further, the display device D**1** displays the selectable parking spaces in such a way that the operator can distinguish between the selected parking space and unselected parking spaces among the selectable parking spaces, by causing at least one of the color, pattern, etc., of the graphics G**12** to vary. Specifically, the display device D**1** indicates that the parking space represented by the graphic G**12**D is selected by the operator. It is possible for the operator to select a desired parking space by touching a portion corresponding to the desired parking space on the touch panel attached to the display device D**1**.

[0157] A graphic G**13** indicates a process flow until the start of autonomous traveling of the shovel **100**. In an example of FIG. **12**, the display device D**1** indicates that the autonomous traveling of the shovel **100** starts after the parking space selection and the route selection, by displaying three text labels "parking space selection", "route selection", and "start traveling". Further, the display device D**1** indicates that the process related to the parking space selection is being performed at present, by causing the color of the text label "parking space selection" to be different from the color of the other two text labels.

[0158] A graphic G**14** represents a current date. In an example illustrated in FIG. **12**, the graphic G**14** indicates that the current date is Jul. 22, 2016.

[0159] A graphic G**15** represents information related to the parking lot. In an example illustrated in FIG. **12**, the graphic G**15** indicates that the name of the parking lot is "***", and the location of the parking lot is "east longitude* north latitude*".

[0160] FIG. **13** illustrates the parking space selection screen GC that is displayed after one of the selectable parking spaces is selected. The parking space selection screen GC illustrated in FIG. **13** is different from the parking space selection screen GC illustrated in FIG. **12** in that a graphic G**16** is displayed and that the color of the text label "route selection" is different from the color of other two text labels in graphic G**13**.

[0161] The graphic G**16** represents routes that can be taken when moving the shovel **100** from the current location to the selected parking space. In an example illustrated in FIG. **13**, the display device D**1** displays graphics G**16**A and G**16**B representing two selectable routes. Further, the display device D**1** displays the selectable routes in such a way that the operator can distinguish between the selected route and an unselected route, by causing at least one of the color, line type, etc., of the graphics G**16** to vary. Specifically, the display device D**1** indicates that the route represented by the graphic G**16**A (solid line) is selected by the operator. It is possible for the operator to select a desired route by touching a portion corresponding to the desired route on the touch panel attached to the display device D**1**.

[0162] Further, in an example illustrated in FIG. **13**, the display device D**1** indicates that the process related to the route selection is being performed at present, by causing the color of the text label "route selection" to be different from the color of the other two text labels.

[0163] After one of the plurality of selectable routes is selected, the controller **30** starts the autonomous traveling of the shovel **100**. During the autonomous traveling of the shovel **100**, the display device D**1** may display a screen indicating that the graphic G**10** representing the shovel **100** moves along the graphic G**16**A representing the selected route. At this time, the display device D**1** indicates that the autonomous traveling of the shovel **100** is being performed at present, by causing the color of the text label "start traveling" to be different from the color of the other two text labels.

[0164] Next, referring to FIG. **14**, another configuration example of the controller **30** will be described. FIG. **14** is a functional block diagram illustrating another configuration example of the controller **30**. In an example of FIG. **14**, the controller **30** is configured to: receive a signal output by at least one of the posture detection device, the space recognition device **71**, the information input device **72**, the positioning device **73**, an error (abnormality) detection sensor **74**, etc.; to perform various calculations; and to output a control command to the proportional valve **31**, etc. The posture detection device includes the boom angle sensor S**1**, the arm angle sensor S**2**, the bucket angle sensor S**3**, the device body inclination sensor S**4**, and the swing angular velocity sensor S**5**.

[0165] The controller **30** illustrated in FIG. **14** is different from the controller **30** illustrated in FIG. **6** mainly in that the controller **30** is connected to the error detection sensor **74**, and that the controller **30** includes a target setting unit F**1**, an error (abnormality) monitoring unit F**2**, a stop determination unit F**3**, an intermediate target setting unit F**4**, a location calculation unit F**5**, an object detection unit F**6**, a velocity command generation unit F**7**, a velocity calculation unit F**8**, a velocity control (limiting) unit F**9**, and a flow rate command generation unit F**10**. Therefore, in the following, descriptions for common parts will be omitted, and different parts will be described in detail.

[0166] The posture detection unit **30**A is configured to detect information related to the posture of the shovel **100** in the same way as the posture detection unit **30**A illustrated in FIG. **6**. In an example of FIG. **14**, the posture detection unit **30**A determines whether the posture of the shovel **100** is a traveling posture. Further, the posture detection unit **30**A is configured to allow performing the autonomous traveling of the shovel **100** in the case where it is determined that the posture of the shovel **100** is a traveling posture.

[0167] The target setting unit F**1** is configured to set a target related to the autonomous traveling of the shovel **100**. In an example of FIG. **14**, the target setting unit F**1** sets, as targets, a parking space in which the shovel **100** is to be parked, and, a route for reaching the parking space, based on an output of the information input device **72**. Specifically, the target setting unit F**1** sets, as the target parking space (target point), a parking space selected by the operator using the touch panel (refer to the graphic G**12**D in FIG. **13**), and sets, as the target route, a route selected by the operator of the shovel **100** using the touch panel (refer to the graphic G**16**A in FIG. **13**).

[0168] The error monitoring unit F**2** is configured to monitor an error (abnormality) of the shovel **100**. In an example of FIG. **14**, the error monitoring unit F**2** determines degrees of an error of the shovel **100** based on an output of the error detection sensor **74**. The error detection sensor **74** is, for example, at least one of a sensor that detects an error of the engine **11**, a sensor that detects an error related to the temperature of the hydraulic oil, etc.

[0169] The stop determination unit F**3** is configured to determine whether it is necessary to stop the shovel **100** based on various information items. In an example of FIG. **14**, the stop determination unit F**3** determines whether it is necessary to stop the shovel **100** that is traveling autonomously based on an output of the error monitoring unit F**2**. Specifically, the stop determination unit F**3** determines that it is necessary to stop the shovel **100** that is traveling autonomously in the case where the degree of an error of the shovel **100**, determined by the error monitoring unit F**2**, exceeds a predetermined degree. On the other hand, in the case where the degree of an error of the shovel **100** determined by the error monitoring unit F**2** is equal to or less than the predetermined degree, the stop determination unit F**3** determines that it is not necessary to stop the shovel **100** that is traveling autonomously, in other words, it is possible for the shovel **100** to continue to perform the autonomous traveling.

[0170] The intermediate target setting unit F**4** is configured to set an intermediate target related to the autonomous traveling of the shovel **100**. In an example of FIG. **14**, in the case where it is determined by the posture detection unit **30**A that the posture of the shovel **100** is a traveling posture and where it is determined by the stop determination unit F**3** that it is not necessary to stop the shovel **100**, the intermediate target setting unit F**4** divides the target route, which is set by the target setting unit F**1**, into a plurality of sections, and sets the end point of each section as an intermediate target point.

[0171] The location calculation unit F**5** is configured to calculate a current location of the shovel **100**. In an example of FIG. **14**, the location calculation unit F**5** calculates the current location of the shovel **100** based on an output of the positioning device **73**.

[0172] A calculation unit F**5** is configured to calculate a difference between a location of an intermediate target point set by the intermediate target setting unit F**4** and the current location of the shovel **100** calculated by the location calculation unit F**5**.

[0173] The object detection unit F**6** is configured to detect an object existing around the shovel **100**. In an example of FIG. **14**, the object detection unit F**6** detects an object existing around the shovel **100** based on an output of the space recognition device **70**. Further, in the case where an object (e.g., a person) existing in the traveling direction of the shovel **100** that is autonomously traveling, the object detection unit F**6** generates a stop command for stopping the autonomous traveling of the shovel **100**.

[0174] The velocity command generation unit F**7** is configured to generate a command related to the traveling speed. In an example of FIG. **14**, the velocity command generation unit F**7** generates a velocity command based on the difference calculated by the calculation unit C**1**. Basically the velocity command generation unit F**7** is configured to generate a velocity command that is larger as the difference is larger. Further, the velocity command generation unit F**7** is configured to generate a velocity command that causes the difference calculated by the calculation unit C**1** to be close to zero.

[0175] The velocity calculation unit F**8** is configured to calculate a current traveling speed of the shovel **100**. In an example of FIG. **14**, the velocity calculation unit F**8** calculates the current traveling speed of the shovel **100** based on the transition of the current location of the shovel **100** calculated by the location calculation unit F**5**.

[0176] A calculation unit C**2** is configured to calculate a speed difference between a traveling speed corresponding to the speed command generated by the velocity command generation unit F**7** and the current traveling speed of the shovel **100** calculated by the velocity calculation unit F**8**.

[0177] The velocity control (limiting) unit F**9** is configured to limit the traveling speed of the shovel **100**. In an example of FIG. **14**, the velocity control (limiting) unit F**9** is configured to output a limit value instead of the speed difference in a case where the speed difference calculated by the calculation unit C**2** exceeds the limit value, and outputs the speed difference as it is in a case where the speed difference calculated by the calculation unit C**2** is equal to or less than the limit value. The limit value may be a pre-registered value, or may be a dynamically calculated value.

[0178] The flow rate command generation unit F**10** is configured to generate a command related to the flow rate of the hydraulic oil that is supplied from the main pump **14** to the hydraulic traveling motor **2**M. In an example of FIG. **14**, the flow rate command generation unit F**10** generates a flow rate command based on the speed difference output by the velocity control (limiting) unit F**9**. Basically the flow rate command generation unit F**10** is configured to generate a flow rate command that is larger as the speed difference is larger. Further, the flow rate command generation unit F**10** is configured to generate a flow rate command that causes the speed difference calculated by the calculation unit C**2** to be close to zero.

[0179] The flow rate command generated by the flow rate command generation unit F**10** is a current command for each of the proportional valves **31**EL, **31**ER, **31**FL, and **31** FR (refer to FIG. **5**A and FIG. **5**B). The proportional valve **31**EL operates in response to the current command, and changes a pilot pressure applied to the left-side pilot port of the control valve **171**. Therefore, the flow rate of the hydraulic oil flowing into the left hydraulic traveling motor **2**ML is adjusted to become a flow rate corresponding to the flow rate command generated by the flow rate command generation unit F**10**. The proportional valve **31**ER operates in the same way. Further, the proportional valve **31**FR operates in response to the current command, and changes a pilot pressure applied to the right-side pilot port of the control valve **172**. Therefore, the flow rate of the hydraulic oil flowing into the right hydraulic traveling motor **2**MR is adjusted to become a flow rate corresponding to the flow rate command generated by the flow rate command generation unit F**10**. The proportional valve **31**FL operates in the same way. As a result, the traveling speed of the shovel **100** is adjusted to become a traveling speed corresponding to the velocity command generated by the velocity command generation unit F**7**. It should be noted that the traveling speed of the shovel **100** is a concept including the traveling direction. With respect to the above, the traveling direction of the shovel **100** is determined based on the rotation speed and the rotation direction of the left hydraulic traveling motor **2**ML, and the rotation speed and the rotation direction of the right hydraulic traveling motor **2**MR.

[0180] According to the above arrangement, it is possible for the controller **30** to realize the autonomous traveling of the shovel **100** from the current location to the target parking space.

[0181] As described above, a shovel **100** according to an embodiment of the present invention includes a lower-part traveling body **1**, an upper-part swing body **3** that is turnably mounted on the lower-part traveling body **1**, a hydraulic traveling motor **2**M as a traveling actuator that drives the lower-part traveling body **1**, a space recognition device **70** that is provided in the upper-part swing body **3**, an orientation detection device **71** that detects information related to a relative relation between an orientation of the upper-part swing body **3** and an orientation of the lower-part traveling body **1**, and a controller **30** as a control device that is provided in the upper-part swing body **3**. Further, the controller **30** is configured to cause the hydraulic traveling motor **2**M to operate, based on an output of the space recognition device **70** and an output of the orientation detection device **71**, and cause the shovel **100** to move to a parking space recognized by the space recognition device **70**. According to the above arrangement, it is possible for the shovel **100** to assist the movement of the shovel **100** to the parking location. As a result, the parking of the shovel **100** into the desired parking space can be performed efficiently. Further, it is possible for the shovel **100** to prevent from contacting other object due to the erroneous operation or the like during parking.

[0182] The shovel **100** includes, for example, an attachment actuator that drives an excavating attachment AT as an attachment attached to the upper-part swing body **3**, and a posture detection device that detects the posture of the excavating attachment AT. The attachment actuator includes, for example, a boom cylinder **7**, an arm cylinder **8**, and a bucket cylinder **9**. The posture detection device includes, for example, a boom angle sensor S**1**, an arm angle sensor S**2**, and a bucket angle sensor S**3**. Further, the controller **30** may be configured to cause the attachment actuator to operate based on an output of the space recognition device and an output of the space recognition device **70**, and may be configured to change the posture of the excavating attachment AT in such a way that the excavating attachment AT does not touch an object recognized by the space recognition device **70**. According to the above arrangement, it is possible for the controller **30** to prevent the excavating attachment AT from touching other objects when operating the hydraulic traveling motor **2**M to move the shovel **100**. The other objects are, an electrical wire, other shovels, vehicles, etc.

[0183] The shovel **100** includes, for example, a hydraulic swing motor **2**A as an actuator used for turning the upper-part swing body **3**. Further, the controller **30** may be configured to cause the hydraulic swing motor **2**A to operate, based on an output of the space recognition device **70** and an output of the orientation detection device **71**, and may be configured to cause the upper-part swing body **3** to turn in such a way that the shovel **100** does not touch an object recognized by the space recognition device **70**. According to the above arrangement, it is possible for the controller **30** to prevent a counter weight, or the like, from touching other objects when operating the hydraulic traveling motor **2**M to move the shovel **100**.

[0184] The shovel **100** includes, for example, the information input device **72**. The information input device **72** may be configured to allow an operator to input a direction of the parking space viewed from the upper-part swing body **3**. Specifically, the information input device **72** may be configured to allow an operator to select the direction of the parking space viewed from the shovel **100** from four directions of front, rear, left, and right. In this case, the space recognition device **70** may be configured to recognize a parking space in a direction selected via the information input device **72**. In other words, the controller **30** may omit recognition of parking spaces by the space recognition device **70** in an unselected direction. According to the above arrangement, it is possible for the controller **30** to determine existence/non-existence of parking spaces in a selected direction, quickly and accurately. Further, it is possible for the controller **30** to omit the determination of existence/non-existence of parking spaces in an unselected direction, and to reduce the calculation load.

[0185] The information input device **72** may be, for example, configured to allow an operator to input a location of the parking space. Specifically, as illustrated in FIG. **10**, the information input device **72** may be configured to allow an operator to select a desired parking space from **27** parking spaces whose longitude, latitude, and altitude are pre-registered. In this case, the space recognition device **70** may be configured to recognize a parking space located at a location selected by using the information input device **72**. According to the above arrangement, it is possible for the controller **30** to, after moving the shovel **100** to a parking space located at a relatively farther location from the current location, cause the shovel **100** to be parked in the parking space.

[0186] As described above, one or more preferred embodiments of the present invention are described in detail. However, the present invention is not limited by the above-described embodiments. The above-described embodiments may be modified or replaced appropriately without departing from the scope of the present invention. Further, features described separately may be combined unless there is a technical inconsistency.

[0187] For example, in the above-described embodiment, a hydraulic operation lever with a hydraulic pilot circuit is described. Specifically, in the hydraulic pilot circuit related to the left operation lever **26**L as an arm operation lever, the hydraulic oil, which is supplied from the pilot pump **15** to the remote control valve of the left operation lever **26**L, is transferred to a pilot port of the control valve **176** with a flow rate corresponding to the opening of the remote control valve that is opened or closed by tilting of the left operation lever **26**L.

[0188] It should be noted, however, that an electric operation lever with an electric pilot circuit may be employed instead of the hydraulic operation lever with a hydraulic pilot circuit. In this case, the lever operation amount of the electric operation lever is input to the controller **30** as an electric signal. Further, an electromagnetic valve (solenoid valve) is provided between the pilot pump **15** and a pilot port of each control valve. The electromagnetic valve is configured to operate in response to an electric signal from the controller **30**. According to the above arrangement, when a manual operation is performed by using the electric operation lever, it is possible for the controller **30** to move each control valve in the control valve **17** by controlling the electromagnetic valve in response to an electric signal corresponding to the lever operation amount to increase or reduce the pilot pressure. It should be noted that each control valve may be formed by an electromagnetic spool valve (solenoid spool valve). In this case, the electromagnetic valve operates in response to an electric signal, corresponding to the lever operation amount of the electric operation lever, from the controller **30**.

[0189] In the case where an electric operation system with an electric operation lever is employed, it is possible for the controller **30** to perform the autonomous control function more easily compared with a case in which a hydraulic operation system with a hydraulic operation lever is employed. FIG. **15** illustrates a configuration example of an electric operation system. Specifically, the electric operation system illustrated in FIG. **15** is an example of a boom operation system used for raising and lowering the boom **4**, and mainly includes a pilot-pressure-operated control valve **17**, a boom operation lever **26**A as an electric operation lever, a controller **30**, an electromagnetic (solenoid) valve **60** for boom raising operation, and an electromagnetic (solenoid) valve **62** for boom lowering operation. The electric operation system illustrated in FIG. **15** can be also applied to a traveling operation system used for moving the lower-part traveling body **1** forward and backward, a swing operation system used for turning the upper-part swing body **3**, an arm operation system used for opening and closing the arm **5**, a bucket operation system used for opening and closing the bucket **6**, etc.

[0190] The pilot-pressure-operated control valve **17** includes a control valve **171** related to the left hydraulic traveling motor **2**ML (refer to FIG. **3**), a control valve **172** related to the right hydraulic traveling motor **2**MR (refer to FIG. **3**), a control valve **173** related to the hydraulic swing motor **2**A (refer to FIG. **3**), a control valve **175** related to the boom cylinder **7** (refer to FIG. **3**), a control valve **176** related to the arm cylinder **8** (refer to FIG. **3**), and a control valve **174** related to the bucket cylinder **9** (refer to FIG. **3**). The electromagnetic valve **60** is configured to adjust a pressure of the hydraulic oil in a line that connects the pilot pump **15** and an up-side pilot port of the control valve **175**. The electromagnetic valve **62** is configured to adjust a pressure of the hydraulic oil in a line that connects the pilot pump **15** and a down-side pilot port of the control valve **175**.

[0191] When an manual operation is performed, the controller **30** generates a boom-up operation signal (electric signal) or a boom-down operation signal (electric signal), in response to an operation signal output by an operation signal generation unit of the boom operation lever **26**A. The operation signal output by the operation signal generation unit of the boom operation lever **26**A is an electric signal that varies according to the operation amount and the operation direction of the boom operation lever **26**A.

[0192] Specifically, the controller **30** outputs a boom-up operation signal (electric signal), corresponding to the lever operation amount, to the electromagnetic valve **60** in the case where the boom operation lever **26**A is operated in the boom-up direction. The electromagnetic valve **60** operates in response to a boom-up operation signal (electrical signal) to control the pilot pressure as a boom-up operation signal (pressure signal) acting on the up-side pilot port of the control valve **175**. Similarly, the controller **30** outputs a boom-down operation signal (electric signal), corresponding to the lever operation amount, to the electromagnetic valve **62** in the case where the boom operation lever **26**A is operated in the boom-down direction. The electromagnetic valve **62** operates in response to a boom-down operation signal (electric signal) to control the pilot pressure as a boom-down operation signal (pressure signal) acting on the down-side pilot port of the control valve **175**.

[0193] In the case where the autonomous control is performed, the controller **30** generates a boom-up operation signal (electric signal) or a boom-down operation signal (electric signal), in response to a correction operation signal (electric signal), instead of in response to an operation signal (electric signal) output by an operation signal generation unit of the boom operation lever **26**A, for example. The correction operation signal may be an electric signal generated by the controller **30**, or may be an electric signal generated by a control device, etc., other than the controller **30**.

[0194] Information obtained by the shovel **100** may be shared by an administrator and operators of other shovels through a shovel management system SYS illustrated in FIG. **16**. FIG. **1** is a schematic diagram illustrating a configuration example of a shovel management system SYS. The management system SYS is a system managing one or more shovels **100**. In an embodiment of the present invention, the management system SYS is mainly formed by a shovel **100**, an assisting device **200**, and a management device **300**. Each of the shovel **100**, the assisting device **200**, and the management device **300** included in the management system SYS may be a single or plural. In an example of FIG. **16**, the management system SYS includes a single shovel **100**, a single assisting device **200**, and a single management device **300**.

[0195] The assisting device **200** is typically a mobile terminal device, and is a notebook PC, a tablet PC, a smart phone, etc., carried by a worker or the like at a construction site. The assisting device **200** may be a mobile terminal device carried by an operator of the shovel **100**. The assisting device **200** may be a fixed terminal device.

[0196] The management device **300** is typically a fixed terminal device, and is, for example, a server computer provided at a management center etc., outside the construction site. The management device **300** may be a portable computer (for example, a mobile terminal device such as a notebook PC, a tablet PC, a smart phone, etc.).

[0197] At least one of the assisting device **200** and the management device **300** may include a monitor and an operation device used for the remote operation. In this case, the operator may operate the shovel **100** while using the operation device for the remote operation. The operation device for the remote operation is connected to the controller **30** installed in the shovel **100** via, for example, a radio communication network such as a near field radio communication network, a mobile telecommunication network, or a satellite communication network.

[0198] Further, although the parking space selection screens GA to GC illustrated in FIG. **8**, FIG. **10**, FIG. **12**, and FIG. **13** are typically displayed by the display device D**1** installed in the cabin **10**, the parking space selection screens GA to GC may be displayed by a display device connected to at least one of the assisting device **200** and the management device **300**. With respect to the above, it becomes possible for a worker using the assisting device **200** or an administrator using the management device **300** to set the target parking space or to set the target route, or the like.

[0199] In the management system SYS for the shovel **100** as described above, the controller **30** of the shovel **100** may transmit, to at least one of the assisting device **200** and the management device **300**, information related to at least one of: the time and place when the parking mode button in pushed; the target trajectory that is used when causing the shovel **100** to autonomously move (when performing the autonomous traveling); and the trajectory that is actually drawn by a predetermined part during the autonomous traveling, or the like. With respect to the above, the controller **30** may transmit, to at least one of the assisting device **200** and the management device **300**, at least one of an output of the space recognition device **70**, an image captured by a monocular camera, etc. The image may be a plurality of images that are captured during the autonomous traveling. Further, the controller **30** may transmit, to at least one of the assisting device **200** and the management device **300**, information related to at least one of: data related to movement of the shovel **100** during the autonomous traveling; data related to the posture of the shovel **100**; and data related to the posture of the excavating attachment, etc. With respect to the above, it becomes possible for a worker using the assisting device **200** or an administrator using the management device **300** to obtain information related to the shovel **100** during the autonomous traveling.

[0200] As described above, in the management system SYS of the shovel **100** according to an embodiment of the present invention, information related to the shovel **100** obtained during the autonomous traveling can be shared by the administrator and the operators of other shovels.

[0201] Further, although the controller **30** is configured to cause the shovel **100** to be parked at the target parking space, the controller **30** may be configured to move the shovel **100** from the parking space to a desired location.

DESCRIPTION OF THE REFERENCE NUMERALS

[0202] **1** Lower-part traveling body; **1**C Crawler; **1**CL Left crawler; **1**CR Right crawler; **2** Swing mechanism; **2**A Hydraulic swing motor; **2**M Hydraulic traveling motor; **2**ML Left hydraulic traveling motor; **2**MR Right hydraulic traveling motor; **3** Upper-part swing body; **4** Boom; **5** Arm; **6** Bucket; **7** Boom cylinder; **8** Arm cylinder; **9** Bucket cylinder; **10** Cabin; **11** Engine; **13** Regulator; **14** Main pump; **15** Pilot pump; **17** Control valve; **18** Aperture; **19** Control pressure sensor; **26** Operation device; **26**A Boom operation lever; **26**D Traveling lever; **26**DL Left traveling lever; **26**DR Right traveling lever; **26**L Left operation lever; **26**R Right operation lever; **28** Discharge pressure sensor; **29**, **29**DL, **29**DR, **29**LA, **29**LB, **29**RA, **29**RB Operation pressure sensor; **30** Controller; **30**A Posture detection unit; **30**B Determination unit; **30**C Autonomous control unit; **31**, **31**AL-**31**DL; **31**AR-**31**DR Proportional valve; **32**, **32**AL-**32**DL, **32**AR-**32**DR Shuttle valve; **40** Center bypass line; **42** Parallel line; **60**, **62** Electromagnetic valve; **70** Space recognition device; **70**F Front sensor; **70**B Rear sensor; **70**L Left side sensor; **70**R Right side sensor; **100** Shovel; **71** Orientation detection device; Information input device; **73** Positioning device; **74** Error detection sensor; **171**-**176** Control valve; **200**

[0203] Assisting device; **300** Management device; AT Excavating attachment; C**1**, C**2** Calculation unit; D**1** Display device; D**2** Sound output device; F**1** Target setting unit; F**2** Error monitoring unit; F**3** Stop determination unit; F**4** Intermediate target setting unit; F**5** Location calculation unit; F**6** Object detection unit; F**7** Velocity command generation unit; F**8** Velocity calculation unit; F**9** Velocity limit unit; F**10** Flow rate command generation unit; NS Switch; S**1** Boom angle sensor; S**2** Arm angle sensor; S**3** Bucket angle sensor; S**4** Device body inclination sensor; S**5** Swing angular velocity sensor

What is claimed is:

1. A shovel comprising:

a lower-part traveling body;

an upper-part swing body that is turnably mounted on the lower-part traveling body;

a traveling actuator that drives the lower-part traveling body;

a space recognition device that is provided in the upper-part swing body;

an orientation detection device that detects information related to a relative relation between an orientation of the upper-part swing body and an orientation of the lower-part traveling body; and

a control device that is provided in the upper-part swing body,

wherein the control device operates the traveling actuator based on an output of the space recognition device and an output of the orientation detection device.

2. The shovel according to claim **1**,

wherein the control device is configured to move the shovel to an input specified space.

3. The shovel according to claim **1**, comprising:

an attachment actuator that drives an attachment attached to the upper-part swing body; and

a posture detection device that detects a posture of the attachment,

wherein the control device is configured to operate the attachment actuator based on an output of the posture detection device and an output of the space recognition device, and to change a posture of the attachment in such a way that the attachment does not touch an object that is recognized by the space recognition device.

4. The shovel according to claim **1**, comprising:

A swing actuator that swings the upper-part swing body,

wherein the control device is configured to operate the swing actuator based on an output of the space recognition device and an output of the orientation detection device, and to cause the upper-part swing body to turn in such a way that the shovel does not touch an object recognized by the space recognition device.

5. The shovel according to claim **1**, comprising:

an information input device,

wherein the information input device is configured to allow an input of a direction of a specified space viewed from the upper-part swing body, and

the space recognition device is configured to recognize the specified space in the direction input through the information input device.

6. The shovel according to claim **1**, comprising:

an information input device,

wherein the information input device is configured to allow an input of a location of a specified space, and

the space recognition device is configured to recognize the specified space in the location input through the information input device.

7. The shovel according to claim **1**, comprising:

wherein the control device is configured to move the shovel based on arrangement information.

8. The shovel according to claim **1**,

wherein the control device determines whether there exists a space through which a body of the shovel can pass.

9. The shovel according to claim **1**,

wherein the control device determines how to operate the traveling actuator based on a target trajectory.

10. The shovel according to claim **9**,

wherein the control device controls the traveling actuator and an attachment actuator that drives an attachment based on location information with respect to the target trajectory.

11. The shovel according to claim **9**,

wherein the control device performs a change of an orientation of a crawler based on the target trajectory by a spin turn.

12. The shovel according to claim **11**,

wherein the control device performs the spin turn and a swing operation simultaneously.

13. The shovel according to claim **1**,

wherein the control device sets a parking space as a target.

14. The shovel according to claim **13**,

wherein the control device sets a target trajectory based on the parking space.

15. The shovel according to claim **1**,

wherein the control device causes a bucket to touch a ground surface after stopping the traveling actuator of the shovel that has entered a parking space.

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